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1921/22

The OHIO STATE UNIVERSITY BULLETIN

VOLUME XXV MARCH 7, 1921 NUMBER 15

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AUG 2 1923

COLLEGE OF ENGINEERING

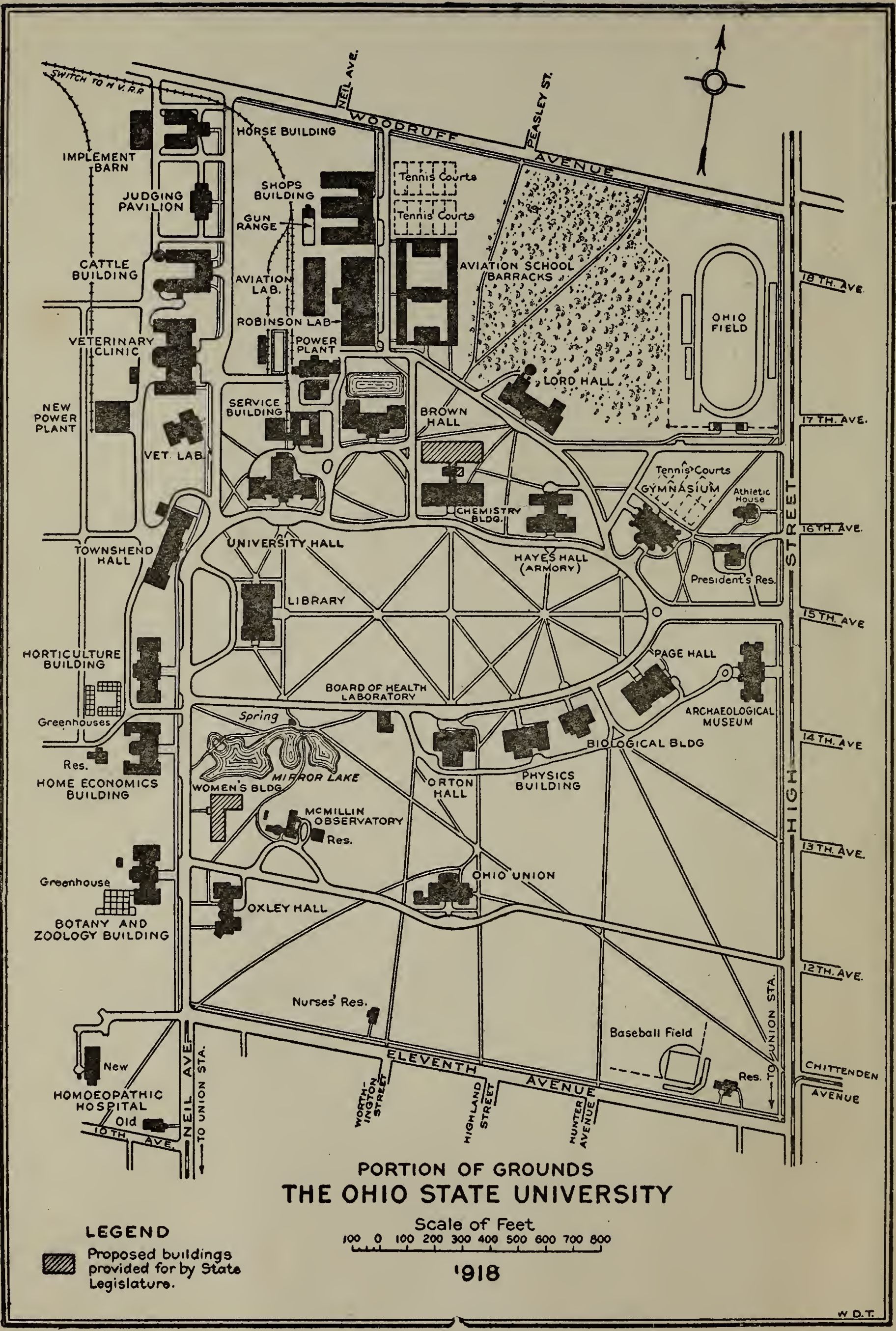
See pages 27 and 31

for list of courses
taken.

1921-1922

PUBLISHED BY THE UNIVERSITY AT COLUMBUS

Entered as second-class matter November 17, 1905, at the Post Office at Columbus, Ohio, under Act of Congress, July 16, 1894. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, Authorized July 10, 1918.



PORTION OF GROUNDS

THE OHIO STATE UNIVERSITY

LEGEND

▨ Proposed buildings provided for by State Legislature.

1918

UNIVERSITY CALENDAR

1921

Summer Session, Monday, June 20 to Friday, August 12.

Entrance examinations, Tuesday to Saturday, 8 A. M., June 21 to 25.

Entrance examinations, Tuesday to Saturday, 8 A. M., September 6 to 10.

Physical examinations for all new students, Friday to Friday, September 16 to 23.

Registration Day—First Semester—Tuesday, September 20.

President's Annual Address, Wednesday, September 21, 11 A. M.

Intelligence tests for Freshmen in the Engineering College, Thursday and Friday, September 22 and 23, from 10 to 12 A. M.

Intelligence tests for all new students, Saturday, September 24.

Latest date for registration of candidates for a degree at the Commencement in June, 1922, October 1.

Registration Day, Short Courses in Agriculture—First Term—Tuesday, October 18.

Mid-semester reports to the Deans concerning delinquent students, Wednesday, November 9.

Thanksgiving recess begins November 23, 1 P. M., and ends November 29, 8 A. M.

Latest date for filing thesis subject, December 15.

Christmas recess begins Thursday, December 22, 6 P. M.

1922

Christmas recess ends Tuesday, January 3, 8 A. M.

Registration Day, Short Courses in Agriculture—Second Term—Tuesday, January 3.

Final examinations, Wednesday, January 25 to Thursday, February 2.

Farmers' Week, Monday, January 30 to Friday, February 3.

First Semester ends Thursday, February 2, 6 P. M.

SECOND SEMESTER

Registration Day—Second Semester—Tuesday, February 7.

University Day, Wednesday, February 22.

Close of Second Term, Short Courses in Agriculture, Friday, March 17.

Mid-semester reports to the Deans, Wednesday, April 5.

Easter recess, Thursday noon, April 13 to Tuesday, April 18, 8 A. M.

Engineering Inspection Trips, May 1 to May 6, inclusive.

Competitive Drill—Cadet Regiment—Saturday, May 27.

Beginning of Thesis period for Seniors, May 20.

Memorial Day, Tuesday, May 30.

Latest date for submitting thesis for final approval, May 25.

Final examinations, Wednesday, May 31 to Thursday, June 8.

Commencement, Tuesday, June 13.

Summer Session, Monday, June 19 to Friday, August 11.

Entrance examinations, Tuesday, June 20 to Saturday, June 24, 8 A. M.

ADMINISTRATION

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Residence: University Grounds—2056

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Office: 100 University Hall—99314
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Cashier (Acting) .... **Floris D. Hane**
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Residence: 1755 N. 4th St.—11954

COLLEGE OF ENGINEERING

Dean .... **Embury A. Hitchcock**
Office: 131 Lord Hall—99331
Residence: 348 W. 8th Ave.—16032; N. 4585

Secretary .... **Robert Meiklejohn**
Office: 131 Lord Hall—99331
Residence: 419 W. Ninth Ave.—16286

THE TEACHING STAFF

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Professor of Astronomy and Director of the Emerson McMillin Observatory

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Professor of Mine Engineering

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Professor of Geology and State Geologist of Ohio

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Frank Harvey Eno, B. Sc., C. E..........222 Sixteenth Avenue
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..................1145 Fairview Ave., Grandview Heights
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......................1751 Roxbury Road, Upper Arlington
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Robert F. Earhart, Ph. D..............371 West Tenth Avenue
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James Renwick Withrow, B. Sc. (Chem.), Ph. D..........
...................................77 Sixteenth Avenue
Professor of Chemistry

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*Absent on leave, 1921-1922.

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Henry E. Hoagland, Ph. D. . . . . .1486 Michigan Avenue
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Olin H. Moore, A. M., Ph. D. . . . . .121 Fourteenth Avenue
Professor of Romance Languages

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Joseph R. Burkey, C. E. . . . . .1639 Greenway Avenue
Substitute Professor of Structural Engineering

ASSOCIATE PROFESSORS

Charles Lincoln Arnold, M. Sc........328 West Eighth Avenue
Associate Professor of Mathematics

Edmund Sewall Manson, Jr., M. Sc...........2 Indianola Court
Associate Professor of Astronomy

ASSISTANT PROFESSORS

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May Thomas, Ph. D.........................1473 Neil Avenue
Assistant Professor of German

Grace Bareis, Ph. D................201 West Eleventh Avenue
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Acting Head of the Department

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Elisabeth Conrad, M. A., Ph. D..........1981 Indianola Avenue
Assistant Professor of Romance Languages

George R. Havens, Ph. D.............Apt. 24, Alhambra Court
Assistant Professor of Romance Languages

*Edward H. Mack, Jr., Ph. D..............1898 Summit Street
Assistant Professor of Chemistry

Paul Murray, Major, Inf., U. S. A..........1820 Summit Street
Assistant Professor of Military Science and Tactics

Ralph C. Benner, First Lieutenant, F. A., U. S. A.........
...................................2045 Waldeck Avenue
Assistant Professor of Military Science and Tactics

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*Absent on leave, 1920-1921.

James Henry Weaver, Ph. D.........................Hilliards
Assistant Professor of Mathematics

William A. Mueller ....85 Midland Avenue
Assistant Professor of Metallurgy

Vera McCoy Masters, M. A.............2172 Indianola Avenue
Assistant Professor of Bacteriology

Ethel C. Scofield, B. S...................30 Thirteenth Avenue
Assistant Professor of Physical Education

Wesley G. France, M. S., Ph. D.........325 West Tenth Avenue
Assistant Professor of Chemistry

Roderick Peattie, S. B., Ph. D................222 King Avenue
Assistant Professor of Geology

Wylie T. Conway, Lieut. Colonel, U. S. A., Rtd...682 East Broad Street
Assistant Professor of Military Science and Tactics

Allan F. McLean, Major, Cav., U. S. A...200 East Thirteenth Avenue
Assistant Professor of Military Science and Tactics

Edward C. Hanford, Major, F. A., U. S. A.......................Apt. 12, Bretton Hall, Norwich Ave. and High Street
Assistant Professor of Military Science and Tactics

Frank E. Kauffman, First Lieutenant, F. A., U. S. A...35 Twelfth Avenue
Assistant Professor of Military Science and Tactics

Carlisle B. Cox, First Lieutenant, Cav., U. S. A...23 Sixteenth Avenue
Assistant Professor of Military Science and Tactics

INSTRUCTORS

Frank H. Haskett ....380 King Avenue
Instructor in Architecture

William J. Norris ....60 East Eighth Avenue
Instructor in Art

Melville F. Webber, A. B...............242 Northwood Avenue
Instructor in Art

Alma Knauber ....93 Fifteenth Avenue
Instructor in Art

Frank Carl Vilbrandt, M. A.........170 West Frambes Avenue
Instructor in Chemistry

James T. Robson, B. Ch. E...........49 East Norwich Avenue
Instructor in Ceramic Engineering

Charles A. Miller ....2474 North Fourth Street
Instructor in Civil Engineering

Claude H. Wall, B. C. E....................183 Dakota Avenue
Instructor in Civil Engineering

Herbert E. Foreman ....1201 Hunter Street
Instructor in Civil Engineering

Montgomery E. Pike, A. B., LL. B.........8 East Broad Street
Instructor in Economics and Sociology

John E. Shepardson, B. Sc..........216 West Woodruff Avenue
Instructor in Electrical Engineering

Wooster Bard Field, C. E. in Arch........22 East Lane Avenue
Instructor in Engineering Drawing

Ralph S. Paffenbarger, B. E. E........15 Huston-Fergus Court
Instructor in Engineering Drawing

Howard F. Yerges, B. E...............323 West Ninth Avenue
Instructor in Engineering Drawing

J. Forest Craig, M. A...............342 East Eleventh Avenue
Instructor in English

Edith Mary Sniffen, M. A...................1550 Neil Avenue
Instructor in English

Sada A. Harbarger, A. M............375 West Eighth Avenue
Instructor in English

Vesta M. Pegg, B. A......................255 Twelfth Avenue
Instructor in English

Gertrude L. Robinson, M. A.......................Worthington
Instructor in English

Helen Morningstar, M. A...............1275 Franklin Avenue
Instructor in Geology

Raymond E. Lamborn, M. A.........105 East Frambes Avenue
Instructor in Geology

Robert F. Webb, A. M..................120 East Lane Avenue
Instructor in Geology

Alice T. Wing, M. A....................231 West Tenth Avenue
Instructor in German

Hortense Rickard, M. A................333 West Tenth Avenue
Instructor in Mathematics

Vaughn B. Caris, B. A..................1244 Harrison Avenue
Instructor in Mathematics

Paul Bucher, B. M. E......................2091 Peasley Street
Instructor in Mechanical Engineering

Karl Willson Stinson, B. M. E............2051 Waldeck Avenue
Instructor in Mechanical Engineering

Percy W. Ott, B. S...................37 East Eleventh Avenue
Instructor in Mechanics

Samuel H. Cobb, A. B., B. P. E.........295 Fourteenth Avenue
Instructor in Physical Education

Darwin Hindman, A. B................2067 Indianola Avenue
Instructor in Physical Education

Clara Raynor-Ranck, B. A..............329 West Ninth Avenue
Instructor in Physical Education

Dorothy S. Gibling, B. A..............148 Chittenden Avenue
Instructor in Physical Education

Dwight A. Woodbury, M. Sc................2195 Summit Street
Instructor in Physics

Alva W. Smith, M. A..................1152 Grandview Avenue
Instructor in Physics

John S. Ward, B. Sc...................164 West Ninth Avenue
Instructor in Physics

Charles W. Jarvis, M. A...........158 East Northwood Avenue
Instructor in Physics

Erwin F. Lowry, A. M.................2464 North High Street
Instructor in Physics

W. Byron Brown, A. B..............205 East Norwich Avenue
Instructor in Physics

Henri Tailliart, B. A...................162 Fourteenth Avenue
Instructor in Romance Languages

Florence Hier, B. A...............119 East Northwood Avenue
Instructor in Romance Languages

Agnes E. Brown, M. A.......Apt. A, Bldg. 15, Indianola Court
Instructor in Romance Languages

Emily Schons, A. M.................1749 North Fourth Street
Instructor in Romance Languages

Arthur S. Sloan, M. A................105 West Eighth Avenue
Instructor in Romance Languages

William F. Smith, A. B...............338 West Eighth Avenue
Instructor in Romance Languages

Bertha P. Arthur, M. A..............37 West Oakland Avenue
Instructor in Romance Languages

Esther L. Bigger, A. M................124 West Ninth Avenue
Instructor in Romance Languages

Robert Foure, B. A..................121 West Eleventh Avenue
Instructor in Romance Languages

G. Nelson Graham, B. A...............1874 North High Street
Instructor in Romance Languages

Raymond L. Grismer, A. B..............1495 Michigan Avenue
Instructor in Romance Languages

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Instructor in Romance Languages

Clement M. Beem ....17 University Place
Instructor in Patternmaking and Founding

Jacob A. Foust ....148 West Frambes Avenue
Instructor in Forging

Ulysses W. Denman ....423 Clinton Street
Instructor in Woodworking

Perry Lisbon Wright ....2093 Peasley Street
Instructor in Blacksmithing

Harold R. Wright ....963 Sullivant Avenue
Instructor in Industrial Arts

Carl M. Senn, B. Sc. (Agr.), B. Sc. (Edu.)....361 Tulane Road
Instructor in Woodworking

THE OHIO STATE UNIVERSITY

The Ohio State University, located in Columbus, is a part of the public educational facilities maintained by the State.

ORGANIZATION

For convenience of administration, the departments of the University are grouped into organizations called colleges. The Ohio State University comprises a Graduate School and eleven Colleges, each under the administration of a Dean and College Faculty, as follows:

Graduate School
College of Agriculture
College of Arts, Philosophy and Science
College of Commerce and Journalism
College of Dentistry
College of Education
College of Engineering
College of Homoeopathic Medicine
College of Law
College of Medicine
College of Pharmacy
College of Veterinary Medicine

SUMMER SESSION

In addition to the above, there is a Summer Session under the supervision of a Director and governing committee for the administration of the regular University courses offered in the summer.

This bulletin of announcements is devoted exclusively to the work of the College of Engineering, offered during the academic year beginning September, 1921.

Note—The University publishes a bulletin descriptive of each college. Copies may be obtained by addressing the University Examiner, The Ohio State University, Columbus, Ohio, and stating the college in which the writer is interested.

THE COLLEGE OF ENGINEERING

The purpose of the College of Engineering is to instruct students in the fundamental sciences and arts upon which all engineering rests, and to impart such special and technical knowledge of the various branches of engineering as will enable its graduates to enter them and maintain themselves while gaining their professional experience. To accomplish this purpose, the work of the College is classified under ten curricula, which are described on the following pages and which lead to the following degrees:

Bachelor of Architecture (B. Arch.)
Bachelor of Architectural Engineering (B. Arch. E.)
Bachelor of Ceramic Engineering (B. Cer. E.)
Bachelor of Chemical Engineering (B. Ch. E.)
Bachelor of Civil Engineering (B. C. E.)
Bachelor of Electrical Engineering (B. E. E.)
Bachelor of Mechanical Engineering (B. M. E.)
Bachelor of Metallurgical Engineering (B. Met. E.)
Bachelor of Engineering in Mining (B. E. M.)
Bachelor of Engineering (B. E.)

The curriculum leading to the degree of B. E. is offered for the benefit of those students who may desire instruction not included in any one of the special curricula, and also for those who may wish an opportunity to pursue a limited number of cultural studies, together with elective engineering studies. It is believed, however, that the severe mental discipline of any of these curricula makes the work of the College of Engineering the equal of any other in general educational value.

FIVE-YEAR CURRICULUM

For the benefit of those who are unable to carry the full schedule on account of outside work for self-support, impaired health, or any other valid reason, any of the regular curricula can be rearranged to cover five instead of four years.

COMBINATION CURRICULA

It is also possible to arrange combination curricula leading to two degrees in five or more years. (See page 39.)

GRADUATE COURSES

Advanced courses in various engineering subjects are offered by the departments of the College of Engineering to those who wish to pursue them. If such courses are pursued with the expectation of receiving credit upon them to apply towards any higher degree, the student must register in the Graduate School, under whose jurisdiction all work for the higher degrees is conducted. For further information, consult the Bulletin of the Graduate School of the University or confer with the Dean or Secretary. (See page 40.)

SPECIAL STUDENT'S CERTIFICATE

A special certificate will be issued to any special student completing a special course of not less than 60 credit hours, approved by the Dean and the head of the department in which the major portion of the student's work lies. The certificate will contain a statement of the subjects taken.

GENERAL INFORMATION

OFFICE HOURS OF THE SECRETARY OF THE COLLEGE

The office of the College of Engineering is in Room 131, Lord Hall. The office hours are 8 to 12 a. m. and 1:30 to 5 p. m. daily, except Saturday. Office hours, Saturday, 8 to 12 a. m.

RESERVE OFFICERS' TRAINING CORPS

Under the law of Congress establishing the land grant colleges, it is required that instruction in Military Science and Tactics be included in the curricula. This instruction is given under the Defense Act of June 3, 1916, establishing in the University the Reserve Officers' Training Corps. Under normal conditions, eight commissioned officers, three warrant officers, and eleven non-commissioned officers of the Regular Army are detailed by War Department to take charge of this department. The Board of Trustees has directed that all male students, special and regular, except those registered in the Colleges of Law, Medicine, Homoeopathic Medicine, and Dentistry, shall complete two years of military service unless especially excused by the Military and Gymnasium Board.

Self-support is not an adequate reason for excusing a student from the requirement in Military Science.

The Reserve Officers' Training Corps is organized as a brigade consisting of two regiments of infantry, each composed of three battalions of four companies each, and one regiment of field artillery, composed of two battalions of three batteries each, a band of sixty pieces, and a trumpet corps. There are two companies of men from the students in the Three-Year Course in Agriculture. The total number of men under arms averages about three thousand.

The course of instruction is both practical and theoretical, and divided into basic and advanced courses in both infantry and field artillery. One-half of the time is devoted to theoretical work in the classroom and one-half of the time to practical work in the field. The basic courses are required of all Freshmen and Sophomores. The advanced courses are elective for Juniors and Seniors. Students completing the advanced course when recommended by the Commandant and the President of the University, are granted a commission as Second Lieutenant in the Officers' Reserve Corps by appointment from the President of the United States. No student is eligible for the advanced course until he has satisfactorily completed the basic course or its equivalent.

The allowance made by the War Department is nearly sufficient to pay for the cadet uniform. This University has adopted its own style of uniform. Students taking advanced courses in Military Science also receive fifty-three cents a day payable quarterly.

The appointment of cadet officers is made usually from those who have served in the Military Department at least one year and as a reward for excellence in their work. No compensation is paid to officers who are completing their first two years of service in the Military Department, the only exception being those who have had the equivalent of the required two years in service elsewhere. The compensation awarded at the end of each year of satisfactory service is thirty dollars for lieutenants, forty dollars for captains, and proportional sums for officers of higher rank.

Service in the band is credited as military service, the positions being assigned after competitive try-out. Members of the band who have completed two years of service in the Military Department or its equivalent are paid at the rate of twenty dollars a year and receive instruction during the four winter months from a competent band master.

THESIS

As a requisite for graduation, each candidate in the College of Engineering must present an acceptable thesis embodying the results of a special study. The subject of this study must lie within the field of the degree sought. The subject must be filed with the head of the department, under whose direction the work is done, on the official blank provided for the purpose not later than December 15th of the University year in which the degree is sought. The completed thesis must be submitted to the professor who has directed the work not later than the second Thursday before Commencement Day for final approval.

If the thesis is then approved the student shall deposit two copies of it with the University Editor not later than noon of the Thursday before Commencement, and shall pay to the Editor a fee covering the cost of binding the same.

THE STILLMAN W. ROBINSON FELLOWSHIP

This fellowship endowed by Stillman W. Robinson, late Professor of Mechanical Engineering, for the encouragement of graduate research in Engineering, has a value of $750 annually and is open to graduates in Mechanical, Civil and Electrical Engineering.

The holder of this fellowship must devote his entire time to graduate work. This should lead to the Master's or the Doctor's degree under the general regulations which obtain in reference to these degrees. For further information or for application blanks address the Dean of the Graduate School or the Secretary of the College of Engineering. All applications should be filed with the Dean of the Graduate School not later than March 15th.

THE E. I. duPONT de NEMOURS FELLOWSHIP

Through the generosity of E. I. duPont de Nemours & Company of Wilmington, Delaware, and in recognition of the services of colleges and universities in training chemists for the emergency of the War, fellowships in chemistry have been established in a number of institutions, one of which is available at the Ohio State University.

The holder of the fellowship must be prepared to engage at once in active research upon a problem distinctly chemical in character, there being no further limitations upon the fellowship. The stipend is $750 per annum, and it is expected that at the conclusion of the year the holder of the fellowship will be able to present his research as a thesis for the degree of Doctor of Philosophy. The donors have not assumed obligation to continue the fellowship beyond the current year, but it is hoped that it will be renewed.

THE GRASSELLI CHEMICAL COMPANY FELLOWSHIP

Through the generosity of the Grasselli Chemical Company of Cleveland, Ohio, a fellowship in Chemistry has been established at the Ohio State University. This fellowship carries with it a stipend of $750. An applicant for the fellowship must have had sufficient training in Chemistry to enable him to begin at once active research work. If the applicant has not received the degree of Doctor of Philosophy, then the research work accomplished may be presented as a dissertation for this degree.

No limitations are placed upon the fellowship other than that the Grasselli Chemical Company may request that the subject of the investigation be chosen from the field of Organic Chemistry rather than that of Inorganic Chemistry or vice versa.

Candidates for this fellowship should file their applications with the Dean of the Graduate School not later than March 15th. Application blanks may be obtained by addressing the Dean of the Graduate School, The Ohio State University.

FEES AND EXPENSES

GENERAL CHARGES

All University fees must be paid at the opening of each semester as a condition of admission to classes. Registration is not complete until all fees have been paid. No student will have any privileges in the classes or laboratories until all fees and deposits are paid.

Since all fees are due and payable as a part of the student's registration, no person should come to the University for registration without money sufficient to cover all his fees and deposits.

Matriculation Fee. Every student upon his **first admission to the University** is required to pay a matriculation fee of $10.00. This fee is paid but once, and is in addition to other University fees and entitles the student to the privileges of membership in the University.

Non-Resident Fee. Every undergraduate student who is not a legal resident of the State of Ohio is required to pay a non-resident fee of $50.00 each semester of his residence in the University in addition to other University fees. The burden of registering under proper residence is placed upon the student. If there is any possible question of his right to legal residence the matter should be brought to the attention of the Registrar and passed upon, previous to registration or the payment of fees. Any student who registers improperly under this rule shall be required to pay not only the non-resident fee, but shall be assessed a penalty of $10.00.

No person shall be considered eligible to register in the University as a resident of the State of Ohio unless he has resided in the State twelve months next preceding the date of his proposed enrollment; and no person shall be considered to have gained a residence in this State for the purpose of registering in the University while he is a student in the University.

The residence of minors shall follow that of the legal guardian.

The residence of wives shall follow that of husbands.

Aliens who have taken out first citizenship papers and who have been residents of Ohio for twelve months next preceding the date of their enrollment in the University, shall be regarded as eligible for registration as residents of Ohio.

Incidental Fee. The fee is twenty dollars each semester.

Former students who do not pay this fee until the third day of the first semester and second day of the second semester, must pay one dollar additional. For each day of delay thereafter, fifty cents is added.

Laboratory Deposit. Students are required to pay for all materials consumed in laboratory work. To meet the cost of these materials, a deposit for each course requiring such supplies is made at the Bursar's office before the work is begun. In Chemistry the deposit is fifteen dollars. In other courses it varies with the amount of materials used. All laboratory supplies are sold at the General Store Room, Chemistry Hall, to students at first cost to the University, and charged against the deposits. Any unused part of the deposits is refunded at the end of the semester.

Students should present their class-cards to the Bursar when they pay laboratory deposits.

Deposit for Uniform. The allowance made by the War Department is nearly sufficient to pay for the cadet uniform. Every student in the Military Department is required to make a deposit of not to exceed thirty dollars for his uniform during his first year of residence. If for any reason he is obliged to leave the University before the close of the academic year, such portion of the deposit that is due the student through attendance will be refunded to him. This refund is at the rate of four dollars for each month that he is in residence at the University and in attendance in the Military Department. If the student remains in attendance during the entire year his full deposit is refunded to him and the uniform becomes his property, free of charge.

OTHER EXPENSES

Locker Fee. The gymnasium is free to all students, but those desiring to use a locker are charged a fee of two dollars a semester, which includes the rental of towels.

Changes in Subjects or Schedule. Changes in subjects or schedule, if made at the request of the student, shall be made only upon the payment of a fee of $1.00 for each change. The fee, in exceptional cases, may be remitted by the Executive Committee of the College.

Graduation Fee. A fee of five dollars, to cover expense of graduation and diploma, is required of each person receiving one of the ordinary degrees from the University, and this fee must be paid before the last Thursday preceding Commencement. A like fee of ten dollars is charged each person receiving one of the higher graduate degrees.

The Ohio Union. A fee of one dollar a semester is paid by all male students at registration. This entitles the student to all the privileges of the Union, consistent with the constitution and house rules governing it.

Textbooks. Students should not purchase textbooks until they are advised by the instructors of their respective classes.

COST OF A YEAR'S WORK

One of the most perplexing questions that confronts a prospective student is what the course is going to cost him a year.

In order to furnish information, we have listed below an estimate of the average payments required by the University for the Freshman year in the College of Engineering, and have estimated the cost for room and boarding at a safe price. These two items are sometimes reduced slightly where two students occupy the same room and where boarding clubs are economically managed. Fees to the University are paid one-half at the beginning of each semester.

Matriculation fee	$ 10 00
Incidental fee	40 00
Ohio Union	2 00
Gymnasium locker	4 00
Deposits to cover laboratory materials and breakage	30 00
Deposit for uniform	30 00
Drawing instruments and supplies	30 00
Books	30 00
Board—36 weeks at $8.00 a week	288 00
Room rent, at $15.00 a month	135 00
General expenses	100 00
	$699 00

The item of general expenses is always subject to the personal habits of the individual, and varies according to the degree of economy exercised.

Note—In order to meet all the necessary expenses of registration, deposit for uniform, books, and other expenditures incident to securing a room and board, a student should come prepared to expend from $100.00 to $125.00 during the first ten days of a semester. After that period his board and room rent will constitute the major part of his expenses.

ADMISSION

The College is open on equal terms to both sexes.

THE ENTRANCE BOARD

The admission of students to the University is in charge of the Entrance Board, which determines the credit that shall be issued on all entrance examinations and certificates and furnishes all desired information to applicants. Correspondence relating to admission should be addressed to the University Examiner, The Ohio State University, Columbus, Ohio.

REQUIREMENTS

For complete entrance credit, an applicant for admission who is under twenty-one years of age, must be a graduate of a high school of the first grade and receive credit by certificate for fifteen units; or he must receive credit by examination for fifteen units.

Of these fifteen units, not less than three shall be in English; three in mathematics (including solid geometry); one in physics; two in some one language (other than English); and six shall be elective, and may include any subject given by any first grade high school.

Applicants under twenty-one years of age may be admitted to the College with a deficiency of one unit.

An applicant over twenty-one years of age may be admitted with a total deficiency of two units.

An applicant with a deficiency in solid geometry must remove this deficiency by examination before he will be admitted to the Sophomore class in descriptive geometry.

An entrance condition in solid geometry cannot be removed by substitution.

An applicant entering with a deficiency in advanced algebra (½ unit) will be assigned to Mathematics 100, which will require his attendance during the succeeding summer session in order to secure admission to Sophomore mathematics.

For admission by examination see page 29, by certificate see page 30 of the *Bulletin of General Information.*

REQUIREMENTS FOR ADMISSION AS A SPECIAL STUDENT UNDER TWENTY-ONE YEARS OF AGE

An applicant under twenty-one years of age who desires to pursue a special plan of work in the University, but who is not a candidate for a degree will be admitted as a special student upon the following conditions:

(a) He must satisfy the regular entrance requirements of the College of Engineering.

(b) He must submit to the Executive Committee of the College for approval, a written statement of the end he has in view, the studies proposed for the attainment of that end, and the probable period of his residence at the University. He will be held as rigidly to his accepted scheme of work as are regular students to their prescribed course of study.

SPECIAL STUDENTS OF MATURE YEARS

A person of mature years who is unable to meet the entrance requirements in all respects, under certain circumstances may be permitted to matriculate for specified courses for which he can demonstrate adequate qualifications. An applicant under twenty-one years of age will not be considered. Inquiry concerning such admission should be addressed to the Entrance Board, and to receive consideration must reach the Board not less than ten days in advance of the opening of the semester.

CURRICULA

OUTLINE OF THE FIRST YEAR'S WORK OF ALL FOUR-YEAR CURRICULA

In order to permit all Engineering students to have a year in which to find out definitely what courses they desire to pursue, the first year of all Engineering curricula, except Architecture, is made uniform. While students are asked to indicate their choice on entering the College, they can change at the end of the first year without any inconvenience.

Note—The figure in parenthesis following the name of each study indicates the number of the study in its department, the other figure indicates the number of credit hours.

First Semester

Mathematics College Algebra and Trigonometry	(131)	5
Chemistry General Chemistry	(105 or 109)*	4
Modern Language French, German or Spanish		4
English Paragraph Writing	(101)	2
Engineering Drawing Elementary Mechanical	(101)	2
Military Science		1
Physical Education Hygiene	(100)	1
Physical Education	(101)	1

Second Semester

Mathematics Trigonometry and Analytics	(132)	5
Chemistry General Chemistry and Qualitative Analysis	(106 or 110)*	4
Modern Language French, German or Spanish		4
English Paragraph Writing	(104)	2
Engineering Drawing Lettering and Projections	(102)	3
Military Science		1
Physical Education	(102)	1

SUMMER SESSION

Shopwork is required in the Summer Session in all Engineering curricula, except Architecture, Architectural and Civil Engineering. In Chemical, Electrical and Mechanical Engineering, Shopwork 109 and 115 are required at the end of the first year. In Ceramic and General Engineering, Shopwork 107, 109 and 115 are offered and two of these must be taken at the end of the first year. In Metallurgical and Mine Engineering, Shopwork 105, 109 and 115 are offered and two of these must be taken at the end of the first year.

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*Students presenting Chemistry as an entrance subject will take Chemistry 109 and 110. Students with no entrance credits in Chemistry will take Chemistry 105 and 106.

ARCHITECTURE

FIRST YEAR

FIRST SEMESTER			SECOND SEMESTER		
Mathematics College Algebra and Trigonometry	(131)	5	Mathematics Trigonometry and Analytics	(132)	5
French	(101 or 103)	4	French	(102 or 104)	4
English Paragraph Writing	(101)	2	English Paragraph Writing	(104)	2
Engineering Drawing Elementary Mechanical	(101)	2	Engineering Drawing Lettering and Projections	(102)	3
Art Elementary Drawing	(131)	2	Art Elementary Drawing	(132)	2
Architecture Elements of Architecture	(131)	2	Architecture Elements of Architecture	(132)	2
Military Science		1	Military Science		1
Physical Education Hygiene	(100)	1	Physical Education	(102)	1
Physical Education	(101)	1			

SECOND YEAR

Mathematics Calculus	(127)	3	Mathematics Calculus	(128)	3
Physics General Physics	(117)	2	Physics General Physics	(118)	2
Engineering Drawing Descriptive Geometry	(107)	3	Architecture Shades, Shadows and Perspective	(124)	3
Art Advanced Drawing	(133)	2	Art Elementary Design	(141)	2
Architecture History of Architecture	(133)	3	Architecture History of Architecture	(134)	3
Architecture Design	(141)	5	Architecture Design	(142)	5
Military Science		1	Military Science		1

SUMMER COURSE: Architecture 120, Architectural Practice or an Architectural Problem. Four credit hours.

THIRD YEAR

Mechanics Statics and Strength of Materials	(103)	5	Civil Engineering Trusses	(124)	3
Art Water Color	(136)	2	Art Water Color	(162)	2
Architecture Architectural Composition	(113)	2	Architecture Wood Construction	(150)	5
Architecture Photography	(111)	2	Architecture History of Architecture	(136)	3
Architecture History of Architecture	(135)	2	Architecture Design	(144)	5
Architecture Design	(143)	5			

SUMMER COURSE: Architecture 121, Architectural Practice or an Architectural Problem. Four credit hours.

Fourth Year

First Semester			Second Semester		
Mechanical Engineering Heating and Ventilating	(121)	3	Civil Engineering Cement and Concrete	(130)	2
Architecture Sanitary Plumbing	(117)	1	Architecture Professional Practice	(116)	4
Architecture Masonry	(151)	3	Architecture Thesis	(118)	5
Architecture Ornament	(147)	4	Architecture Design	(146)	5
Architecture Design	(145)	5	Art Drawing from Life	(164)	2
Art Drawing from Life	(163)	2			

For thesis requirements see page 18.

ARCHITECTURAL ENGINEERING

FOR FIRST YEAR SEE PAGE 27

Second Year

Mathematics Calculus	(141)	5	Mathematics Calculus	(142)	5
Physics General Physics	(111)	3	Physics General Physics	(112)	3
Engineering Drawing Descriptive Geometry	(107)	3	Architecture Shades, Shadows and Perspective	(124)	3
Architecture Elements of Architecture	(131)	2	Architecture Elements of Architecture	(132)	2
Architecture History of Architecture	(133)	3	Architecture History of Architecture	(134)	3
Art Elementary Drawing	(131)	2	Art Elementary Drawing	(132)	2
Military Science		1	Military Science		1

Summer Course: Architecture 120. Architectural Practice or an Architectural Problem. Four credit hours.

Third Year

Mechanics Statics and Strength of Materials	(101)	5	Mechanics Strength of Materials	(104)	2
Mechanical Engineering Materials of Construction	(123)	2	Civil Engineering Trusses	(124)	3
Architecture Architectural Composition	(113)	2	Architecture Photography	(111)	2
Architecture History of Architecture	(135)	2	Architecture Wood Construction	(150)	5
Architecture Design	(141)	5	Architecture. Design	(142)	5
Electrical Engineering Illumination	(117)	2			

Summer Course: Architecture 121, Architectural Practice or an Architectural Problem. Four credit hours.

FOURTH YEAR

FIRST SEMESTER			SECOND SEMESTER		
Mechanical Engineering Heating and Ventilating	(121)	3	Civil Engineering Cement and Concrete	(130)	2
Mechanical Engineering Experimental Engineering Laboratory	(169)	2	Civil Engineering Surveying	(128)	2
Architecture Plumbing	(153)	2	Architecture Professional Practice	(116)	4
Architecture Masonry	(151)	3	Architecture Thesis	(118)	5
Architecture Design	(143)	5	Architecture Fire Protection	(123)	2
Civil Engineering Tall Buildings	(125)	3	Civil Engineering Concrete Design	(129)	3

For thesis requirements see page 18.

CERAMIC ENGINEERING

FOR FIRST YEAR SEE PAGE 27

SECOND YEAR

Mathematics Calculus	(141)	5	Mathematics Calculus	(142)	5
Physics General Physics	(111)	3	Physics General Physics	(112)	3
Engineering Drawing Descriptive Geometry	(103)	3	Engineering Drawing Machine Drawing	(104)	3
Metallurgy Ceramic Chemistry	(145)	4	Metallurgy Ceramic Chemistry	(146)	4
Ceramic Engineering Clays	(141)	3	Ceramic Engineering Clay Wares	(142)	3
Military Science		1	Military Science		1

THIRD YEAR

Mechanics Statics and Strength of Materials	(101)	5	Mechanics Strength of Materials	(104)	2
Chemistry Physical Chemistry	(159)	3	Geology	(168)	3
Mine Engineering Mine Surveying	(113)	3	Civil Engineering Trusses	(124)	3
Ceramic Engineering Drying and Burning	(143)	3	Ceramic Engineering Decoration of Clay Wares	(144)	3
Ceramic Engineering Calculations	(105)	3	Ceramic Engineering Physical, Chemical Measurements	(108)	4
Metallurgy Pyrometry	(125)	1	Mechanical Engineering Mechanism and Machine Design	(110)	3
			Ceramic Engineering Junior Inspection Trip	(133)	

FOURTH YEAR

FIRST SEMESTER			SECOND SEMESTER		
Ceramic Engineering Laboratory	(111)	5	Ceramic Engineering Laboratory	(112)	5
Ceramic Engineering Designing	(113)	5	Ceramic Engineering Designing	(114)	5
Civil Engineering Cement and Concrete	(118)	2	Ceramic Engineering Thesis	(116)	4
Metallurgy Fuel	(117)	2	Ceramic Engineering Refractories and Furnaces	(146)	3
Mine Engineering Principles of Mining	(115)	2			
Mineralogy Thermo-Chemical Mineralogy	(105)	2			

For thesis requirements see page 18.

CHEMICAL ENGINEERING

FOR FIRST YEAR SEE PAGE 27

SECOND YEAR

Mathematics Calculus	(141)	5	Mathematics Calculus	(142)	5
Physics General Physics	(111)	3	Physics General Physics	(112)	3
Engineering Drawing Descriptive Geometry	(103)	3	Engineering Drawing Machine Drawing	(104)	3
Chemistry Quantitative Analysis	(119)	4	Chemistry Quantitative Analysis	(120)	4
Chemistry Advanced General Chemistry	(113)	2	Chemistry Advanced General Chemistry	(114)	2
Military Science		1	Military Science		1

SUMMER COURSE: Chemistry 125. The equivalent of eight weeks spent in shop or factory work, or in the engineering department of an industrial plant or other organized work than that of a chemical laboratory merely. Work to be done between the second and third years.

THIRD YEAR

Mechanics Statics and Strength of Materials	(101)	5	Mechanics Kinetics and Hydraulics	(102)	5
Engineering Drawing Technical Drawing	(121)	2	Engineering Drawing Technical Drawing	(122)	2
Metallurgy Fuel	(117)	2	Mineralogy Crystallography and Mineralogy	(102)	3
Metallurgy Iron and Steel	(119)	2	Chemistry Organic Chemistry, lectures	(152)	2
Chemistry Organic Chemistry, lectures	(151)	2	~~Chemistry~~ ~~Junior Inspection Trip~~	~~(181)~~	
Chemistry Organic Chemistry, laboratory	(153)	2	Elective		5 to 7
Mechanical Engineering Steam Engineering	(107)	3	German (Scientific)		

Electives in third year, second semester, must be chosen from the group of courses as Chemical Engineering Electives; or from the following courses, subject to the approval of the department concerned: Metallurgy 110, 4 hours, General Metallurgy; Metallurgy 112, 2 hours, Calorimetry and Mine Gas Analysis.

FOURTH YEAR

FIRST SEMESTER			SECOND SEMESTER		
Mechanical Engineering Machine Design	(127)	5	Mechanical Engineering Machine Design	(144)	5
Chemistry Physical Chemistry	(157)	3	Chemistry Physical Chemistry	(158)	3
Chemistry Industrial Chemistry	(177)	2	Chemistry Industrial Chemistry	(178)	2
Chemistry Industrial Chemistry, laboratory	(185)	3	Chemistry Industrial Chemistry, laboratory	(186)	2
Electrical Engineering Elementary Electrical Engineering	(101)	5	Chemistry Thesis	(140)	4
			Chemistry Inspection Trip	(182 or 184)	
			Elective		2

For thesis requirements see page 18.

CIVIL ENGINEERING

FOR FIRST YEAR SEE PAGE 27

SECOND YEAR

Mathematics Calculus	(141)	5	Mathematics Calculus	(142)	5
Physics General Physics	(111)	3	Physics General Physics	(125)	5
Engineering Drawing Descriptive Geometry	(105)	3	Engineering Drawing Advanced Descriptive Geometry	(106)	3
Civil Engineering Land Surveying and Field Practice	(101 & 101a)	4 and 1	Civil Engineering Railroad Surveying and Field Practice	(102 & 102a)	4 and 1
Civil Engineering Topographic Drawing	(103)	2	Military Science		1
Military Science		1			

SUMMER COURSES: Civil Engineering 104 and 111, each four weeks of six days a week. Four credit hours for each course. Field work in surveying. Required in second and third years respectively.

THIRD YEAR

Astronomy Geodesy and Least Squares	(104)	3	Astronomy Geodesy and Least Squares	(105)	3
Mechanics Statics and Strength of Materials	(101)	5	Mechanics Kinetics and Hydraulics	(102)	5
Civil Engineering Topographic Surveying	(105)	3	Civil Engineering Timber Construction	(108)	3
Civil Engineering Applied Descriptive Geometry	(107)	2	Civil Engineering Roads and Pavements	(106)	3
Civil Engineering Sanitary Engineering	(109)	3	†Civil Engineering Stresses in Structures	(110)	4
Geology	(168)	3	‡Civil Engineering Trusses	(124)	3
			‡Civil Engineering Engineering Reports	(138)	1

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†Civil Engineering group.
‡Municipal and Sanitary Engineering group.

FOURTH YEAR

CIVIL ENGINEERING GROUP

FIRST SEMESTER		
Civil Engineering Bridge Design	(113)	4
Civil Engineering Cement and Concrete	(130)	2
Civil Engineering Masonry Construction	(115)	3
Mechanical Engineering Laboratory	(173)	5
Civil Engineering Railway Maintenance	(141)	3
or		
Civil Engineering Tall Buildings	(125)	3
or		
Electrical Engineering	(103)	3

SECOND SEMESTER		
Civil Engineering Railway Location	(112)	4
or		
Civil Engineering Advanced Bridge Design	(114)	4
Civil Engineering Water Supply	(117)	3
Civil Engineering Masonry Structures and Contracts	(116)	3
Civil Engineering Thesis	(122)	3
Civil Engineering Concrete Design	(129)	3
Mechanical Engineering Hydraulic Machinery	(142)	2
or		
Mechanical Engineering Hydraulic Power	(150)	3

For thesis requirements see page 18.

FOURTH YEAR

MUNICIPAL AND SANITARY ENGINEERING GROUP

Civil Engineering Cement and Concrete	(130)	2
Civil Engineering Masonry Construction	(115)	3
Mechanical Engineering Laboratory	(173)	5
Civil Engineering Thesis	(119)	1
Civil Engineering Municipal Engineering	(139)	3
*Bacteriology General Bacteriology	(107)	4
or		
*Chemistry Quantitative Analysis	(119)	3

Civil Engineering Water Supply	(117)	3
Civil Engineering Masonry Structures and Contracts	(116)	3
Civil Engineering Thesis	(122)	3
Civil Engineering Concrete Design	(129)	3
Civil Engineering Sanitary and Water Supply Design	(140)	3
*Bacteriology Water Exam., Sewage Disposal, Water Filtration	(114)	3
or		
*Chemistry Water Analysis	(176)	3

For thesis requirements see page 18.
Students will not be permitted to change groups during the Senior year.

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*Alternative courses.

ELECTRICAL ENGINEERING

FOR FIRST YEAR SEE PAGE 27

SECOND YEAR

FIRST SEMESTER

Mathematics Calculus	(141)	5
Physics Mechanics and Heat	(113)	5
Engineering Drawing Descriptive Geometry	(103)	3
Physics Electricity and Magnetism	(129)	2
Shopwork Machine Work	(119)	3
Military Science		1

SECOND SEMESTER

Mathematics Calculus	(142)	5
Physics Electricity and Magnetism	(130)	6
Physics Wave Motion, Sound and Light	(132)	2
Engineering Drawing Technical Drawing	(110)	2
Shopwork Advanced Machine Work	(121)	3
Military Science		1

THIRD YEAR

Mechanics Statics and Strength of Materials	(101)	5
Physics Electrical Measurements and Photometry	(135)	5
Mechanical Engineering Heat Power Engineering	(105)	3
Mechanical Engineering Mechanism and Machine Design	(101)	3
Engineering Drawing Technical Drawing	(111)	2

Mechanics Kinetics and Hydraulics	(102)	5
Electrical Engineering Direct Current Machinery	(104)	5
Mechanical Engineering Heat Power Engineering	(106)	3
Mechanical Engineering Laboratory	(160)	2
Electrical Engineering Applications, A. C. Prin.	(106 & 108)	3
Electrical Engineering Inspection Trip	(132 or 136)	

SUMMER COURSE: Electrical Engineering 139, Experience in Practice. Eight weeks during any summer vacation. (To be first required of the class graduating in 1922.)

FOURTH YEAR

Mechanical Engineering Laboratory	(175)	3
Electrical Engineering Alternating Current Laboratory	(111)	3
Electrical Engineering Alternating Current Machinery	(109)	3
Electrical Engineering Electrical Machine Design	(121)	3
Electrical Engineering	(*)	3
Electrical Engineering Thesis	(127)	1
Elective		2

For thesis requirements see page 18.

Electrical Engineering Alternating Current Laboratory	(112)	3
Electrical Engineering Transmission	(124)	3
Mechanical Engineering Machine Design	(112)	2
Electrical Engineering Thesis	(128)	5
Electrical Engineering Inspection Trip	(130 or 134)	
Elective		2 to 5

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*One of the following: (113) Railways, (115) Telephony, (117) Illumination (119) Wireless Telegraphy.

GENERAL ENGINEERING

FOR FIRST YEAR SEE PAGE 27

Second Year

First Semester			Second Semester		
Mathematics Calculus	(141)	5	Mathematics Calculus	(142)	5
Chemistry Quantitative Analysis	(119)	4	Chemistry Quantitative Analysis	(120)	4
Physics General Physics	(113)	5	Physics General Physics	(125)	5
Engineering Drawing Descriptive Geometry	(103)	3	Engineering Drawing Machine Drawing	(104)	3
Military Science		1	Military Science		1

(1) In addition to the two years outlined above, the student shall obtain credit for 72 semester hours in order to complete the requirements for his degree.

(2) Of these 72 hours, 10 hours must be Mechanics 101 and 102, which shall ordinarily be completed during the third year, and the production of a thesis, subject to the approval of the department concerned, carrying four hours credit during the fourth year.

(3) At least 20 hours shall be selected from technical Engineering subjects, and 20 hours shall be selected from either technical Engineering subjects or from those sciences fundamental to Engineering which are included in the Bulletin of the College of Engineering. These subjects must be approved by the Engineering Department in which the student's principal work is done, and by the Secretary of the College of Engineering.

(4) The remaining 18 hours shall be selected from any work of the University to which the student is eligible, subject to the approval of the Engineering Department having supervision over the last two years of the student's work.

(5) Junior and Senior inspection trips to be taken with the department in which the major work is done.

For thesis requirements see page 18.

MECHANICAL ENGINEERING

FOR FIRST YEAR SEE PAGE 27

SECOND YEAR

FIRST SEMESTER			SECOND SEMESTER		
Mathematics Calculus	(141)	5	Mathematics Calculus	(142)	5
Physics Mechanics and Heat	(113)	5	Physics General Physics	(119)	3
Engineering Drawing Descriptive Geometry	(103)	3	Physics Laboratory	(138)	2
Shopwork Foundry Work	(105)	2	Engineering Drawing Machine Drawing	(104)	3
Shopwork Chipping and Filing	(107)	2	Shopwork Machine Work	(119)	3
Shopwork Advanced Pattern-Making	(111)	1	Civil Engineering Surveying	(128)	2
Military Science		1	Military Science		1

SUMMER COURSE: Mechanical Engineering 139. Practical experience in an engineering industry. Eight weeks during the second or third summer vacation. (To be first required of the class graduating in 1923.)

THIRD YEAR

Mechanics Statics and Strength of Materials	(101)	5	Mechanics Kinetics and Hydraulics	(102)	5
Engineering Drawing Technical Drawing	(111)	2	Architecture Photography	(111)	2
Metallurgy Fuel	(117)	2	Civil Engineering Timber and Masonry	(126)	2
Metallurgy Iron and Steel	(119)	2	Mechanical Engineering Mechanism	(114)	3
Metallurgy Fuel Analysis and Calorimetry	(131)	1	Mechanical Engineering Mechanism Drawing	(116)	1
Mechanical Engineering Steam Power Plants	(103)	3	Mechanical Engineering Laboratory	(164)	2
Shopwork Advanced Machine Work	(121)	3	Mechanical Engineering Steam Power Plants	(104)	4
			Mechanical Engineering Inspection Trip	(130 or 134)	

FOURTH YEAR

Civil Engineering Trusses	(124)	3	*Mechanical Engineering Steam Turbines	(146)	2
Electrical Engineering Elementary Electrical Engineering	(101)	5	*Mechanical Engineering Hydraulic Power	(150)	3
Mechanical Engineering Machine Design	(127)	5	*Elective		3
Mechanical Engineering Gas Engines and Producers	(125)	2	Mechanical Engineering Machine Design	(144)	5
Mechanical Engineering Thermodynamics	(129)	2	Mechanical Engineering Hydraulic Machinery	(142)	2
Mechanical Engineering Laboratory	(179)	2	Mechanical Engineering Laboratory	(190)	6
			Mechanical Engineering Thesis	(148)	3
			Mechanical Engineering Inspection Trip	(130 or 134)	

For thesis requirements see page 18.

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*Alternative courses. One must be taken.

METALLURGICAL ENGINEERING

FOR FIRST YEAR SEE PAGE 27

Second Year

First Semester		
Mathematics Calculus	(141)	5
Physics General Physics	(111)	3
Engineering Drawing Descriptive Geometry	(103)	3
Metallurgy Metallurgical Analysis	(106)	4
Mine Engineering Mine Surveying	(113)	3
Military Science		1

Second Semester		
Mathematics Calculus	(142)	5
Physics General Physics	(112)	3
Geology	(168)	3
Metallurgy Alloy Analysis	(107)	3
Mineralogy Crystallography and Mineralogy	(102)	4
Military Science		1

Summer Course: Metallurgy 136. Four credit hours. Eight weeks of approved work in a metallurgical plant in the summer time. A report of the summer's work to be made in writing and if possible before students.

Third Year

Mechanics Statics and Strength of Materials	(101)	5
Metallurgy Fuel	(117)	2
Metallurgy Iron and Steel	(119)	2
Mineralogy Determinative Mineralogy	(104)	3
Metallurgy Fire Assaying	(105)	2
Mine Engineering Principles of Mining	(115)	2

Mechanics Kinetics and Hydraulics	(102)	5
Metallurgy General Metallurgy of Non-Ferrous Metals	(110)	4
Metallurgy Technical Gas and Fuel Analysis	(112)	3
Civil Engineering Trusses	(124)	3
Metallurgy Metallography	(120)	2
Metallurgy Inspection Trip	(130)	

Fourth Year

Metallurgy Metallurgical Construction	(127)	4
Mineralogy Thermo-Chemical Mineralogy	(105)	2
Metallurgy Advanced Metallography	(133)	3
Mechanical Engineering Mechanical Laboratory	(191)	4
Electrical Engineering	(103)	3
Elective		4

For thesis requirements see page 18.

Metallurgy Metallurgical Construction	(128)	4
Electrical Engineering Electrical Equipment	(142)	2
Metallurgy Advanced Metallography	(134)	3
Metallurgy Ore Dressing and Coal Washing	(113)	4
Metallurgy Thesis	(116)	3
Elective		3

MINE ENGINEERING

FOR FIRST YEAR SEE PAGE 27

SECOND YEAR

FIRST SEMESTER		
Mathematics Calculus	(141)	5
Physics General Physics	(111)	3
Engineering Drawing Descriptive Geometry	(103)	3
Metallurgy Metallurgical Analysis	(106)	3
Mine Engineering Mine Surveying	(103)	4
Military Science		1

SECOND SEMESTER		
Mathematics Calculus	(142)	5
Physics General Physics	(125)	5
Geology General Geology	(160)	5
Mineralogy Crystallography and Mineralogy	(102)	3
Mine Engineering Mine Trip	(110)	
Military Science		1

SUMMER COURSE: Mine Engineering 108. Four credit hours. Eight weeks of approved work in a mine or mining plant. A report of the summer's work to be made in writing and if possible before students.

THIRD YEAR

Mechanics Statics and Strength of Materials	(101)	5
Metallurgy Fuel	(117)	2
Metallurgy Iron and Steel	(119)	2
Mineralogy Determinative Mineralogy	(104)	3
Mine Engineering Mining Problems	(117)	3
Metallurgy Alloy Analysis	(107)	3

Mechanics Kinetics and Hydraulics	(102)	5
Metallurgy General Metallurgy of Non-Ferrous Metals	(110)	4
Civil Engineering Trusses	(124)	3
Metallurgy Ore Dressing and Coal Washing	(113)	4
Mine Engineering Prospecting and Preliminary Operations	(122)	3
Mine Engineering Inspection Trip	(132)	

FOURTH YEAR

Mine Engineering Development and Methods of Mining	(123)	3
Mine Engineering Mine Design	(127)	3
Mechanical Engineering Laboratory	(191)	4
Electrical Engineering	(103)	3
Metallurgy Fire Assaying	(105)	2
Geology Economic Geology	(167)	3

Mine Engineering Mine Operations	(124)	3
Mine Engineering Mine Design	(128)	3
Mine Engineering Mine Examinations and Reports	(126)	3
Electrical Engineering Electrical Equipment	(142)	2
Metallurgy Technical Gas and Fuel Analysis	(112)	3
Mineralogy Microscopic Petrography	(111)	2
Mine Engineering Thesis or	(116)	3
Mine Engineering Mine Reports	(130)	3

For thesis requirements see page 18.

RESERVE OFFICERS' TRAINING CORPS

The Faculty of the College of Engineering has passed the following regulations to enable its students to take advantage of the Reserve Officers' Training Corps. See page 17.

1. That the first two years of the various Engineering curricula remain as they are at present.

2. That those students who have completed two academic years of service in the Senior Division of the Reserve Officers' Training Corps, and who have been selected for further military training by the President of the University and the Professor of Military Science and Tactics, and who execute the written agreement or contract to pursue the two years advanced curriculum as prescribed in Section 35 of General Orders No. 49, shall receive no academic credit for the prescribed physical work or military science of said advanced curriculum, but may receive academic credit to the amount of three hours a week during four semesters for the theoretical instruction in military subjects of said curriculum.

3. That a student taking this special military training shall be allowed to substitute, during four semesters, three credit hours of military subjects for which academic credit is given, for the same number of hours of subjects which are now a part of the curriculum leading to the degree sought.

4. That the selection of the subjects in the present curricula for which military credits may be substituted shall be determined by the Executive Committee of the College and the department in which the major work of the student lies.

COMBINATION CURRICULA

Combination curricula leading to two Engineering degrees can be arranged for any two of the foregoing degrees. The amount of additional time will be at least thirty semester hours in excess of that required for one, and may be more. In no case will the student be required to take all of the work not common to the two curricula as published.

For instance a joint curriculum, Mechanical and Electrical Engineering, can be taken in five years. Where the curricula are more diverse, such as Civil Engineering and Mechanical Engineering, six years may be required.

ARTS-ENGINEERING CURRICULA

For the benefit of those who desire to possess the advantage of a wider general culture and a broader foundation than can be given in the limits of a four-year professional curriculum, a combination of three years in the College of Arts, Philosophy and Science and three years in the College of Engineering can be so adjusted as to enable the student to secure the degree of Bachelor of Arts and the appropriate Engineering degree.

GRADUATE WORK

The Graduate School has administrative control of the graduate work in all of the colleges of the University.

Master's Degree. The degree which will be conferred upon candidates whose major work lies in Engineering, will be that of Master of Science, (M. Sc.). The course of study will consist of one major and either one or two minors, at least one of the minors being in a different department from that in which the major is taken. A residence of one year devoted wholly to graduate work is required, but graduates of this University may complete not more than half of the required work at another institution offering equivalent opportunities for study. Except in certain special cases, a satisfactory thesis is required.

Professional Engineering Degree. Upon nomination by the Faculty of the College of Engineering, the appropriate Professional Engineering degree of Architect, Architectural Engineer, Ceramic Engineer, Chemical Engineer, Civil Engineer, Electrical Engineer, Engineer of Mines, Mechanical Engineer, or Metallurgical Engineer, may be granted to graduates of this University upon any one of the following plans:

First: Four years of acceptable professional experience and an approved thesis.

Second: A Master of Science degree from this University with a major in Engineering, followed by two years of acceptable professional experience and an approved thesis.

Third: One year of acceptable professional experience, followed by one year of approved study at this University, with an appropriate engineering major and an approved thesis.

DEPARTMENTS OF INSTRUCTION

ARCHITECTURE

Office, 105 Brown Hall

PROFESSORS BRADFORD, CHUBB, AND SMITH,
ASSISTANT PROFESSOR RONAN, MR. HASKETT

131. Elements of Architecture. Two credit hours. First semester. Architecture, first year; Architectural Engineering, second year. Concurrent with Art 131, Engineering Drawing 101.

132. Elements of Architecture. Two credit hours. Second semester. Architecture, first year; Architectural Engineering, second year. Prerequisite, Architecture 131, and concurrent with Art 132 and Engineering Drawing 102.

133. History of Architecture. Three credit hours. First semester. Architecture and Architectural Engineering, second year. Concurrent, Architecture 131 and Art 131.

134. History of Architecture. Three credit hours. Second semester. Architecture and Architectural Engineering, second year. Prerequisite, Architecture 133.

135. History of Architecture. Two credit hours. First semester. Architecture and Architectural Engineering, third year. Prerequisite, Architecture 134.

History of renaissance architecture.

136. History of Architecture. Three credit hours. Second semester. Architecture, third year. Prerequisite, Architecture 135.

History of modern architecture.

141. Design. Five credit hours. First semester. Architecture, second year; Architectural Engineering, third year. Prerequisite, Architecture 132.

142. Design. Five credit hours. Second semester. Architecture, second year; Architectural Engineering, third year. Prerequisite, Architecture 141.

150. Wood Construction. Five credit hours. Second semester. Architecture and Architectural Engineering, third year. Prerequisites, Architecture 141 and Mechanics 103.

143. Design. Five credit hours. First semester. Architecture, third year; Architectural Engineering, fourth year. Prerequisite, Architecture 142.

144. Design. Five credit hours. Second semester. Architecture, third year. Prerequisite, Architecture 143.

145. Design. Five credit hours. First semester. Architecture, fourth year. Prerequisite, Architecture 144.

146. Design. Five credit hours. Second semester. Architecture, fourth year. Prerequisite, Architecture 145.

123. Fire Protection. Two credit hours. Second semester. Architectural Engineering, fourth year. Concurrent, Civil Engineering 125.

151. Masonry. Three credit hours. First semester. Architecture and Architectural Engineering, fourth year. Prerequisite, Architecture 150. Mr. Bradford.

147. Ornament. Four credit hours. First semester. Architecture, fourth year. Prerequisites, Architecture 144 and 113. Mr. Chubb.

153. Plumbing. Two credit hours. First semester. Architectural Engineering, fourth year.

111. Photography. Two credit hours. Either semester. Architecture, Architectural and Mechanical Engineering, third year. Prerequisite, Chemistry 105-106 or 109-110. Mr. Haskett.

113. Principles of Architectural Composition. Two credit hours. First semester. Architecture and Architectural Engineering, third year. Prerequisite, Architecture 134. Mr. Chubb.

116. Professional Practice. Four credit hours. Second semester. Architecture and Architectural Engineering, fourth year. Prerequisite, Architecture 151. Mr. Bradford.

117. Sanitary Plumbing. One credit hour. First semester. Architecture, fourth year. Mr. Bradford.

118. Thesis. Five credit hours. Second semester. Architecture and Architectural Engineering, fourth year. Mr. Bradford, Mr. Chubb and Mr. Ronan.

120. Summer Work. Four credit hours. The equivalent of four weeks of work in an architect's office, or a problem in design assigned by the department. Between the second and third years.

121. Summer Work. Four credit hours. The equivalent of four weeks of work in an architect's office, or a problem in design assigned by the department. Between the third and fourth years.

122. Photography. Two credit hours. Second semester. Prerequisite, Architecture 111. Mr. Haskett.

124. Shades, Shadows, and Perspective. Three credit hours. Second semester. Architecture and Architectural Engineering, second year. Prerequisite, Engineering Drawing 107. Mr. Ronan.

FOR GRADUATES

201-202. Architecture.

203-204. Architecture: Research Work.

For description of graduate courses in this department see the Bulletin of the Graduate School.

ART

Office, 203 Hayes Hall

PROFESSOR KELLEY, ASSISTANT PROFESSOR ROBINSON,
MR. NORRIS, MR. WEBBER, MISS KNAUBER

131-132. Elementary Drawing. Two credit hours. The year. Four laboratory hours each week. Architecture, first year; Architectural Engineering, second year.

This course is designed to develop a thorough knowledge of form and values in black and white, also the use of freehand perspective.

Art 131 is given also during the second semester.

133. Advanced Drawing. Two credit hours. Either semester. Four laboratory hours each week. Architecture, second year. Prerequisite, Art 131-132.

This course is designed to give the students some freedom in the use of drawing as a medium of expression. Drawing from the antique and the costume model.

141. Elementary Design. Two credit hours. Either semester. Architecture, second year. Prerequisite, Art 131.

The principles of the theory and practice of design.

136. Water Color. Two credit hours. First semester. Architecture, third year. Prerequisites, Art 133 and 141.

162. Water Color. Two credit hours. Second semester. Architecture, third year. Prerequisite, Art 136.

163-164. Drawing from Life. Two credit hours. The year. Architecture, fourth year.

ASTRONOMY

Office, Emerson McMillin Observatory

PROFESSOR LORD, ASSOCIATE PROFESSOR MANSON

104-105. Astronomy, Geodesy, and Least Squares. Three credit hours. The year. Civil Engineering, third year. Prerequisite, the calculus. Mr. Lord, Mr. Manson.

107-108. Advanced Astronomy. Three to five credit hours. The year. Prerequisite, the calculus. Mr. Lord, Mr. Manson.

109-110. The Theory of Lenses. Four credit hours. The year. Prerequisite, the calculus. Mr. Lord.

111-112. Introduction to Celestial Mechanics. Three to five credit hours. The year. Prerequisite, the calculus. Mr. Manson.

BACTERIOLOGY

Office, 202 Veterinary Laboratory

PROFESSORS MORREY AND STARIN, ASSISTANT PROFESSOR MASTERS, AND DEPARTMENT ASSISTANTS

107. General Bacteriology. Four or five credit hours. First semester. Civil Engineering (Municipal and Sanitary Engineering group), fourth year, alternate with Chemistry 119. Mr. Morrey, Mrs. Masters, and department assistants.

This course is a prerequisite to all elective courses in the department and is designed to prepare for special work. The lectures consider the botanical relationship of bacteria, their morphology, classification, effect of physical and chemical environment, action on food material, etc. The laboratory work includes preparation of the ordinary culture media and making of cultures on these media, staining methods, and some typical biochemical actions.

114. Water Examination, Sewage Disposal, Water Filtration. Two to five credit hours. Second semester. Civil Engineering (Municipal and Sanitary Engineering group), alternate with Chemistry 176. Prerequisite, Bacteriology 107. Mr. Morrey, Mrs. Masters.

A study of the methods and devices used in these processes and of the organisms concerned. The modern water filtration and sewage disposal plants of the City of Columbus afford most excellent opportunities for practical demonstration and also for study of special problems.

CERAMIC ENGINEERING

Office, 233 Lord Hall

PROFESSOR WATTS, ASSISTANT PROFESSOR HARROP,
MR. ROBSON, MR. LYSATT

105. Ceramic Calculations. Three credit hours. First semester. Ceramic Engineering, third year. Prerequisite, Ceramic Engineering 101. Mr. Robson.

Solution of chemical and physical problems involved in compounding ceramic mixtures, including wet blending. Also instruction in development of series, containing one, two, and three variables.

108. Physical and Chemical Measurements of Clays and Other Ceramic Materials. Four credit hours. Second semester. Ceramic Engineering, third year. Prerequisite, Ceramic Engineering 105. Mr. Watts, Mr. Robson.

Application of physical chemical laws to ceramic materials and compounds.

Laboratory practice in determination of the vital physical and chemical properties of ceramic mixtures and compounds in the plastic, dry, and vitrified and fused states.

111. Laboratory Work in Ceramics. Five credit hours. First semester. Ceramic Engineering, fourth year. Prerequisites, Ceramic Engineering 108 and 144. Mr. Watts, Mr. Robson.

Practice in the production of heavy clay wares, including the making of bodies, slips, engobes and glazes. All ware made is burned and tested.

112. Laboratory Work in Ceramics. Five credit hours. Second semester. Ceramic Engineering, fourth year. Prerequisite, Ceramic Engineering 111. Mr. Watts, Mr. Robson.

Practice in the production of the fine ceramic wares, including the making of bodies and glazes and the production of stains and colors. The burning of the ware is studied by the class with the aid of various means of temperature measurement and control.

113. Ceramic Designing. Five credit hours. First semester. Ceramic Engineering, fourth year. Prerequisite, Ceramic Engineering 143. Mr. Harrop.

Designing, estimating cost of and writing specifications for factory structures, machinery equipment, kilns, driers, power plants, chimneys, etc.

114. Ceramic Designing. Five credit hours. Second semester. Ceramic Engineering, fourth year. Prerequisite, Ceramic Engineering 113. Mr. Harrop.

A continuation of Ceramic Engineering 113.

116. Thesis. Four credit hours. Second semester. Ceramic Engineering, fourth year.

133. Junior Inspection Trip. Second semester. Ceramic Engineering, third year.

141. Ceramic Lectures. Three credit hours. First semester. Ceramic Engineering, second year. Mr. Watts.

The origin, occurrence and distribution of clays and other ceramic materials, their physical properties and the systems of measuring same.

142. Ceramic Lectures. Three credit hours. Second semester. Ceramic Engineering, second year. Mr. Harrop.

The winning and preparation of ceramic materials and the forming of ceramic wares.

143. Ceramic Lectures. Three credit hours. First semester. Ceramic Engineering, third year. Mr. Harrop.

Drying and burning of ceramic wares.

144. Ceramic Lectures. Three credit hours. Second semester. Ceramic Engineering, third year. Mr. Watts.

Ceramic bodies, glazes and colors.

146. Refractories and Furnaces. Three credit hours. Second semester. Ceramic Engineering, fourth year. Mr. Watts, Mr. Harrop.

Lectures on refractories, their physical and chemical composition and properties, their utilization and testing. Mr. Watts.

Lectures on laboratory and industrial furnaces for high temperatures. Mr. Harrop.

FOR GRADUATES

201-202. Research Work.

203-204. Testing of Clays with Reference to their Industrial Adaptability.

205-206. Porcelain for Electrical and Other Special Purposes.

207-208. Advanced Experimental Work.

For description of graduate courses in this department see the Bulletin of the Graduate School.

CHEMISTRY

Office, 100 Chemistry Building

PROFESSORS McPHERSON, FOULK, HENDERSON, EVANS, AND WITHROW, ASSISTANT PROFESSORS BOORD, HOLLINGSWORTH, MACK AND FRANCE, MR. VILBRANDT, AND DEPARTMENT ASSISTANTS

105. Elementary Chemistry. Four credit hours. First semester. One lecture, one quiz, and six laboratory hours each week. No prerequisite. Mr. Evans and department assistants.

An introductory course in the chemistry of the non-metals arranged for students who have not offered chemistry as a unit for admission to the University. This course is to be followed by Chemistry 106 in the second semester.

106. Elementary Chemistry and Qualitative Analysis. Four credit hours. Second semester. One lecture, one quiz, and six laboratory hours each week. Prerequisite, Chemistry 105. Mr. Evans and department assistants.

An introductory course in the chemistry of the metals, the laboratory work constituting an elementary course in qualitative analysis.

109. General Chemistry. Four credit hours. First semester. One lecture, one quiz, and six laboratory hours each week. Prerequisite, one unit of chemistry offered for admission to the University. Mr. Evans and department assistants.

A general course in the chemistry of the non-metals arranged for students who have had a satisfactory course in chemistry in the secondary schools. This course is to be followed by Chemistry 110 in the second semester.

110. General Chemistry and Qualitative Analysis. Four credit hours. Second semester. One lecture, one quiz, and six laboratory hours each week. Prerequisite, Chemistry 109. Mr. Evans and department assistants.

A general course in the chemistry of the metals, the laboratory work constituting an introductory course in qualitative analysis.

113-114. Advanced General Chemistry. Two credit hours. The year. One lecture and one quiz each week. Chemical Engineering, second year. Prerequisite, Chemistry 106 or 110. Mr. Henderson.

This course is arranged for all students who decide to continue chemistry beyond the first year. It consists of a review of the more difficult topics of the first year courses, together with the development of other topics not taken up in those courses. It should be accompanied by quantitative analysis or some other laboratory course.

119-120. Quantitative Analysis. Four credit hours. The year. One quiz and nine laboratory hours each week. Chemical and General Engineering, second year; Chemistry 119 alternate with Bacteriology 107, Civil Engineering (Municipal and Sanitary Engineering group), fourth year. Prerequisite, Chemistry 106 or 110. Mr. Foulk, Mr. Hollingsworth and department assistants.

The fundamental course in quantitative analysis comprising the elementary principles of gravimetric and volumetric analysis with typical analytical methods. The course must be accompanied by Chemistry 124 in the second semester, excepting by special permission of the instructor, and it is desirable that it be accompanied by course 113-114. The laboratory is open every day, morning and afternoon.

125. Chemical Engineering Summer Work. Required summer practice To be done between the second and third years in Chemical Engineering. Prerequisite, Chemistry 120. Mr. Withrow.

This summer practice work is required of all students in the course in Chemical Engineering. It represents the equivalent of eight weeks spent in shop or factory work or in the engineering department of an industrial plant, or in organized industrial work other than that of a purely chemical laboratory.

136. The Reading of Chemical Literature. Two credit hours. Second semester. Two quizzes each week. Chemical Engineering, third year, elective. Prerequisite, one year of German. Mr. Foulk.

The object of this course is to afford practice in the rapid reading of German chemical literature, the selections being made with special reference to the technical terms of chemistry.

140. Chemical Engineering Thesis. Four credit hours. Second semester. Chemical Engineering, fourth year. Prerequisite, three years of the course in Chemical Engineering. Conducted by any permanent member of the department staff.

Laboratory work on some problem chosen to develop power of independent investigation, and a written report on this work in the form of a typewritten thesis ready for binding.

151-152. Organic Chemistry. Two credit hours. The year. Two lectures each week. Chemical Engineering, third year. Prerequisites, Chemistry 114 and 120. Mr. McPherson.

This is the fundamental course in organic chemistry arranged for all students expecting to specialize in chemistry, and required for students in Chemical Engineering. The laboratory work is described under the following course numbers.

153-154. Organic Chemistry (Laboratory). Two or three credit hours. The year. Six or nine laboratory hours each week. Chemistry 153, Chemical Engineering, third year; Chemistry 154, elective. Prerequisite or concurrent courses, Chemistry 151-152. Mr. Boord and assistants.

This course comprises the laboratory work naturally belonging with courses 151-152, and should in general accompany these courses. It consists of the preparation of a series of typical organic compounds, and a study of their properties.

155. Quantitative Organic Analysis. Two credit hours. First semester. Six conference and laboratory hours each week. Elective. Prerequisite, Chemistry 154. Mr. Boord.

Practice in the standard methods available for the quantitative analysis of organic compounds, including methods of combustion, together with the quantitative estimation of the organic radicals present in various compounds.

156. Qualitative Organic Analysis. Two credit hours. Second semester. Six conference and laboratory hours each week. Elective. Prerequisite, Chemistry 154. Mr. Boord.

A study of the systematic classification of organic compounds with reference to methods of identification. The processes of separation, purification, and identification of organic compounds from mixtures.

157-158. Physical Chemistry. Three credit hours. The year. Three lectures each week. Chemical Engineering, fourth year. Prerequisites, Chemistry 114, 120, 152, and Physics 104, 106 or 112, except by special permission of the instructor. Mr. Mack.

The fundamental course in physical chemistry arranged for all students specializing in chemistry, and required of all students in Chemical Engineering. It conforms to the usual course as offered in most universities.

159. Physical Chemistry (Ceramics). Three credit hours. First semester. Three lectures each week. Ceramic Engineering, third year. Prerequisite, Ceramic Engineering 102 or Chemistry 120. Mr. Henderson.

A course in the application of physical chemistry to ceramic problems with special emphasis upon viscosity, surface tension, plasticity, the phase rule, and colloids.

161. Physical Chemistry (Laboratory). Two or three credit hours. Either semester. Six or nine laboratory hours each week. Elective. Prerequisite or concurrent, Chemistry 157-158. Mr. Mack.

An elementary course in physicochemical measurements, including such topics as molecular weights and conductivity, together with some practice in glass blowing.

165. Quantitative Analysis. Two credit hours. First semester. Two quizzes each week. Elective. Prerequisite, Chemistry 120. Mr. Foulk.

The course consists of quizzes only, based upon a study of one of the larger textbooks of quantitative analysis. The procedures described therein are treated as illustrative material to show how the analytical chemist makes use of general chemical principles in developing methods of analysis.

167. Gas Analysis. Three to five credit hours. First semester. One lecture and six to twelve laboratory hours each week. Chemical Engineering, third year, elective. Prerequisite, Chemistry 120. Mr. Hollingsworth.

An introductory course in gas analysis, including some of its important technical applications.

168. Advanced Qualitative Analysis. Three to five credit hours. Second semester. One quiz and six to twelve laboratory hours each week. Chemical Engineering, third year, elective. Prerequisite, Chemistry 120. Mr. Hollingsworth.

The general system of qualitative analysis as published by A. A. Noyes and his associates forms the basis of this course. It includes the more abundant of the so-called rare elements, and emphasizes such points as the detection of small quantities of substances and rough estimates of the percentages of the various constituents in a sample.

169. Advanced Quantitative Analysis. Three to five credit hours. First semester. One conference and six to twelve laboratory hours each week. Elective. Prerequisite, Chemistry 120. Mr. Foulk.

An extension of the first year's course in quantitative analysis. The laboratory exercises include (1) a somewhat difficult determination; (2) an exact standardization of a volumetric solution by two or more independent methods; and (3) the preparation of a pure compound and its use in the study of a method of analysis.

171. Chemical Bibliography. One credit hour. First semester. Lecture, quiz, and library practice. Elective. Prerequisite, twenty-six credit hours of chemistry. Mr. Boord.

Designed to train the advanced student in the use of the chemical library and instruct him in the character of the various journals, dictionaries, handbooks and tables there available. The use of the abstract journals is especially emphasized.

173. Chemical Biography. One credit hour. Second semester. One lecture hour each week. Elective. Prerequisite, twenty-six credit hours of chemistry. Mr. Henderson.

Designed to familiarize advanced undergraduate students with the leading personages in chemistry, particularly in recent and contemporary times, as well as with the available sources of information relating to such persons.

176. Water Analysis. Three credit hours. Second semester. Two lectures and three laboratory hours each week. Chemical Engineering, third year, elective; Civil Engineering (Municipal and Sanitary Engineering group), fourth year, alternate with Bacteriology 114. Prerequisite, Chemistry 120. Mr. Foulk.

The methods of water analysis for both sanitary and industrial purposes, the interpretation of analytical results, and the fundamental principles of water purification.

177-178. Industrial Chemistry. Two credit hours. The year. Two lectures each week. Chemical Engineering, fourth year. Prerequisite, Chemistry 114 and 153. Mr. Withrow.

The fundamental lecture course in industrial chemistry, dealing with the problems of the chemical industries, and placing stress upon the economic questions involved in chemical manufacturing, the materials of plant construction as well as the operations involved in and the principles underlying the application of chemistry to a selected number of chemical industries. The work of the first semester deals especially with the inorganic industries while that of the second semester is related to the organic industries.

181. Inspection Trip to the West. May 1st to 6th, 1922. Required in Chemical Engineering, both third and fourth years.

Given only in even years. Prerequisite or concurrent for Seniors, Chemistry 185 and 186.

Trip includes Dayton, Cincinnati, Gary, Chicago, Detroit, Toledo and possibly other places. The entire expense need not exceed $60.00. A satisfactory written report upon the work of the trip and an examination are required.

182. **Inspection Trip to the East.** April 30th to May 5th, 1923. Required in Chemical Engineering, both third and fourth years. Given only in odd years. Prerequisite or concurrent for Seniors, Chemistry 185 and 186.

Trip includes Akron, Cleveland, Buffalo, Niagara Falls, Pittsburgh and possibly other places. The entire expense need not exceed $60.00. A satisfactory written report upon the work of the trip and an examination are required.

184. **Written Reports (Chemical Engineering).** No credit hours. Concurrent, Chemistry 177-178. Mr. Withrow.

A substitute course for Chemistry 182, allowed only upon presentation of reasons satisfactory to the instructor in charge. The course consists of assigned readings, designed to familiarize the student with all that can be found in the literature regarding Chemical Engineering and specified industrial chemical processes, together with a full written report.

185. **Industrial Chemistry.** Three credit hours. First semester. One conference and eight laboratory hours each week. Chemical Engineering, fourth year. Prerequisites, Chemistry 119 and 120; prerequisite or concurrent, Chemistry 177. Mr. Withrow, Mr. Vilbrandt and assistants.

An introduction to industrial chemical research through assigned manufacturing problems. The specific problems are so chosen as to disclose the fundamental principles underlying the assigned industry, and practice is afforded in the preparation of written reports. Weekly inspection trips are taken to plants in and around Columbus.

186. **Industrial Chemistry.** Two credit hours. Second semester. One hour conference and five laboratory hours each week. Chemical Engineering, fourth year. Prerequisite, Chemistry 185. Mr. Withrow, Mr. Vilbrandt and assistants.

A continuation of Chemistry 185 with additional laboratory work on technical methods of control as applied to industrial chemical processes.

187. Inorganic Preparations. Three credit hours. Either semester. One conference and six laboratory hours each week. Chemical Engineering, third year, elective. Prerequisites, Chemistry 114, 120. Mr. Henderson.

The methods employed in the preparation of pure inorganic compounds; the chief classes of such compounds; and the laboratory preparation of a number of examples sufficient to develop reasonable technique in applying the methods and to illustrate the classes.

192. The Rare Elements. Two credit hours. First semester. Two lectures each week. Elective. Prerequisite, Chemistry 114, 120. Given biennially. Given in 1921-1922. Mr. Henderson.

A course of lectures on the chemistry of the less familiar elements, emphasizing their relations to the well-known elements, as well as their technical applications.

194. Applied Electrochemistry. Two credit hours. Second semester. Two lectures each week. Elective. Prerequisite, Chemistry 158, except by special permission of the instructor. Mr. Withrow.

A survey of the electrochemical industries and a discussion of the principles underlying the application of the electric current in chemical industries.

196. Colloid Chemistry. Two credit hours. Second semester. Two lectures each week. Elective. Prerequisite or concurrent, Chemistry 158. Mr. Henderson.

A course of illustrated lectures upon the preparation and properties of colloids, their significance in the various industries and in physiological processes, together with such related topics as adsorption, setting of plastics, and color phenomena. Laboratory work in these topics may be elected as Course 209-210.

CHEMICAL ENGINEERING ELECTIVES

Chemistry 136, 2 hours, second semester
Chemistry 154, 2 or 3 hours, second semester
Chemistry 155, 2 hours, first semester
Chemistry 156, 2 hours, second semester

Chemistry 161, 2 hours, first or second semester
Chemistry 165, 2 hours, first semester
Chemistry 167, 3 or 5 hours, first semester
Chemistry 168, 3 or 5 hours, second semester
Chemistry 169, 3 or 5 hours, first semester
Chemistry 171, 1 hour, first semester
Chemistry 173, 1 hour, second semester
Chemistry 176, 3 hours, second semester
Chemistry 187, 3 hours, first or second semester
Chemistry 197, 2 hours, first semester
Chemistry 194, 2 hours, second semester
Chemistry 196, 2 hours, second semester

FOR GRADUATES

201-202. Physical Chemistry.

203-204. Advanced Organic Chemistry.

205-206. Advanced Organic Preparations.

209-210. Advanced Inorganic Preparations.

*213. Historical Chemistry.

215. Seminary in Organic Chemistry.

217. Seminary in Organic Chemistry.

218. Seminary in Organic Chemistry.

221. Seminary in Inorganic Chemistry.

224. Seminary in Physical Chemistry.

225-226. Seminary in Industrial Chemistry.

235-236. Chemical Research.

239-240. Seminary in Analytical Chemistry.

241-242. Advanced Industrial Chemistry.

For description of graduate courses in this department see the Bulletin of the Graduate School.

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*Not given in 1921-1922.

CIVIL ENGINEERING

Office, 108 Brown Hall

PROFESSORS SHERMAN, ENO, AND MORRIS, ASSISTANT PROFESSORS SLOANE AND SHANK, MR. MILLER, MR. WALL, MR. FOREMAN

101. Land Surveying. Four credit hours. First semester. Four recitations each week. Civil Engineering, second year. Prerequisites, Mathematics 132, Engineering Drawing 102. Mr. Sherman, Mr. Eno, Mr. Sloane.

Care and use of instruments. Farm, city and hydrographic surveying.

101a. Field Practice. One credit hour. First semester. Three hours each week in field. Civil Engineering, second year. Prerequisite or concurrent, Civil Engineering 101. Mr. Sloane and department instructors.

Field exercises in the use of instruments and surveying.

102. Railroad Surveying. Four credit hours. Second semester. Four recitations each week. Civil Engineering, second year. Prerequisites, Civil Engineering 101 and 101a. Mr. Sherman, Mr. Sloane.

Simple, compound and transition curves, frogs, switches and earthwork.

102a. Field Practice. One credit hour. Second semester. Three hours each week in field. Civil Engineering, second year. Prerequisite or concurrent, Civil Engineering 102. Mr. Sloane and department instructors.

Field practice in laying out curves, frogs, switches and earthwork.

103. Topographic Drawing. Two credit hours. First semester. Six hours each week in drafting room. Civil Engineering, second year. Prerequisite, Engineering Drawing 102. Mr. Sherman, Mr. Eno.

Exercises in black ink and color topographic drawing.

104. Summer Surveying Camp. Four credit hours. Civil Engineering, at close of second year. Prerequisites, Civil Engineering 101a and 102a. Mr. Sloane and department instructors.

Four weeks of six days each of ten hours a day, from the middle of June to the middle of July.

105. Topographic Surveying. Three credit hours. First semester. Nine hours each week in field or drawing-room. Civil Engineering, third year. Prerequisites, Civil Engineering 101, 102, and 104. Mr. Sloane, Mr. Miller.

Field and office work in four or five kinds of topographic surveying.

106. Roads and Pavements. Three credit hours. Second semester. Three recitations each week. Civil Engineering, third year. Prerequisites, Civil Engineering 102 and 104. Mr. Eno.

A study of materials and the principles of construction for rural highways and city pavements.

107. Applied Descriptive Geometry. Two credit hours. First semester. One recitation and one drawing period each week. Civil Engineering, third year. Prerequisite, Engineering Drawing 106. Mr. Sloane.

Descriptive geometry and projections applied to engineering structures in timber, steel, and masonry.

108. Timber Construction. Three credit hours. Second semester. Recitations and drawing. Civil Engineering, third year. Prerequisite, Engineering Drawing 105; concurrent, Mechanics 102. Mr. Sloane, Mr. Miller.

Design of timber structures, identification and properties of various trees and timbers.

109. Sanitary Engineering. Three credit hours. First semester. Three recitations each week. Civil Engineering, third year. Prerequisites, Civil Engineering 102 and 104. Mr. Eno.

A study of the principles of sewage collection systems as applied to the design of separate and combined sewers and storm drains and the study of sewage disposal.

110. Stresses in Structures. Four credit hours. Second semester. Four recitations each week. Civil Engineering (Civil Engineering group), third year. Prerequisite or concurrent, Mechanics 102. Mr. Morris.

A course in the theory of stresses in roofs and bridges.

111. Summer Surveying Camp. Four credit hours. Civil Engineering, at close of third year. Prerequisites, Civil Engineering 104 and 105. Mr. Sloane and department instructors.

Four weeks of six days each of ten hours a day, from the middle of June to the middle of July.

112. Railway Location. Four credit hours. Second semester. Four recitations each week. Optional with Civil Engineering 114, Civil Engineering (Civil Engineering group), fourth year. Prerequisites, Civil Engineering 102 and 111 and Mechanics 102. Mr. Sherman.

A railway project used to illustrate engineering economics in construction, operation and finance.

113. Bridge Design. Four credit hours. First semester. Four recitations each week. Civil Engineering (Civil Engineering group), fourth year. Prerequisite, Civil Engineering 110.

A course in designing and detailing roofs and bridges.

114. Advanced Bridge Design. Four credit hours. Second semester. Four recitations each week. Optional with Civil Engineering 112, Civil Engineering (Civil Engineering group), fourth year. Prerequisite, Civil Engineering 113.

The theory of stresses in and design of cantilever, swing and arch bridges.

115. Masonry Construction. Three credit hours. First semester. Three recitations each week. Civil Engineering, fourth year. Prerequisites, Civil Engineering 111, Mechanics 102. Mr. Sherman.

Review of the materials of masonry construction, and of the general subject of foundations.

116. Masonry Structures and Contracts. Three credit hours. Second semester. Three recitation, lecture or drawing periods each week. Civil Engineering, fourth year. Prerequisite, Civil Engineering 115. Mr. Sherman.

Dams, retaining walls, piers, abutments, culverts, first two-thirds of term. Contracts and specifications, last third.

117. Water Supply. Three credit hours. Second semester. Three recitations each week. Civil Engineering, fourth year. Prerequisites, Civil Engineering 111, Mechanics 102. Mr. Eno.

A study of hydrology, sources and character of water supply, water-borne diseases, construction details of waterworks, the purification, distribution and operation of public water supplies.

118. Cement and Concrete. Two credit hours. First semester. Two recitations each week. Ceramic Engineering, fourth year. Prerequisites, Mechanics 102 or 104. Mr. Shank.

Recitations on concrete materials and theory of proportioning concrete and theory of stresses in reinforced concrete.

119. Thesis. One credit hour. First semester. Civil Engineering (Municipal and Sanitary Engineering group), fourth year. Prerequisites, Civil Engineering 110 and 111.

122. Thesis. Three credit hours. Second semester. Civil Engineering, fourth year. Prerequisite, Civil Engineering 119.

124. Trusses. Three credit hours. Either semester. Three recitations each week first three-fourths of semester. Drawing-room work last one-fourth of semester. Architecture, Architectural Engineering, Ceramic Engineering, Civil Engineering (Municipal and Sanitary Engineering group), Metallurgical and Mine Engineering, third year; Mechanical Engineering, fourth year. Prerequisite or concurrent, Mechanics 102 and 104.

Stresses in and design of steel-framed buildings.

125. Tall Buildings. Three credit hours. First semester. Three lectures or recitations each week. Architectural Engineering, fourth year; optional in Civil Engineering (Civil Engineering group), fourth year. Prerequisite, Civil Engineering 124 or concurrent, Civil Engineering 113. Mr. Burkey.

Stresses in and design of steel-framed office buildings.

126. Timber and Masonry. Two credit hours. Second semester. Two lectures or recitations each week. Mechanical Engineering, third year. Prerequisite, Mechanics 101.

128. Plane Surveying. Two credit hours. Second semester. One lecture and one field exercise of three hours each week. Architectural Engineering, fourth year; Mechanical Engineering, second year. Prerequisites, Engineering Drawing 102, Mathematics 132.

129. Concrete Design. Three credit hours. Second semester. Three recitations each week. Architectural and Civil Engineering, fourth year. Prerequisites, Civil Engineering 113 or 124, Mechanical Engineering 123 or 173, and prerequisite or concurrent, Civil Engineering 118 or 130. Mr. Morris.

Design of reinforced concrete structures.

130. Cement and Concrete. Two credit hours. Either semester. Two three-hour laboratory periods each week. Architecture, Architectural and Civil Engineering, fourth year. Prerequisite, Mechanics 102 or 103.

Recitations and laboratory work in concrete materials, including the testing and mixing of them.

138. Engineering Reports. One credit hour. Second semester. One recitation or report period each week. Civil Engineering (Municipal and Sanitary Engineering group), third year. Prerequisite, Civil Engineering 109. Mr. Eno.

Discussions and written reports upon various municipal and engineering activities and structures.

139. Municipal Engineering. Three credit hours. First semester. Three recitations each week. Civil Engineering (Municipal and Sanitary Engineering group), fourth year. Prerequisite, Civil Engineering 106. Mr. Eno.

A course covering city planning, street cleaning and maintenance, garbage and wastes disposal, and kindred subjects.

140. Sanitary and Water Supply Design. Three credit hours. Second semester. One recitation and two drawing periods each week. Civil Engineering (Municipal and Sanitary Engineering group), fourth year. Prerequisite, Civil Engineering 109, and concurrent, Civil Engineering 117. Mr. Eno.

The working of sanitary and water supply problems, assigned readings, the design of sewage collection and water distribution systems, and the design of sewage disposal and water purification plants and appurtenances.

141. Railway Maintenance. Three credit hours. First semester. Three recitations each week. Optional with Civil Engineering 125, Civil Engineering (Civil Engineering group), fourth year. Prerequisites, Civil Engineering 102 and 111.

Railway maintenance problems. Design of tracks and structures. Visits of inspection.

FOR GRADUATES

201-202. Investigation and Design.

203. Railway Maintenance of Way.

204. Railway Yards and Terminals.

205. Rail and Water Transportation.

206. River Regulation and Improvement.

207. Design Work in Sewage Disposal Plants.

208. Design Work in Municipal Water Supplies.

209. Advanced Bridge Design.

210. Concrete Structural Design.

For description of graduate courses in this department see the Bulletin of the Graduate School.

ECONOMICS

Office, 5 Page Hall

PROFESSORS HAGERTY, SEMBOWER, FISHER, HAYES AND HOAGLAND, MR. PIKE, AND DEPARTMENT ASSISTANTS

101-102. Principles of Economics. Three credit hours. The year. Mr. Hayes, instructor and assistants.

A study of the laws of production, exchange, distribution and consumption of wealth, combined with an analysis of the industrial action of men as regards land, labor, capital, money, credit, rent, interest, wages, etc. Textbook, lectures, and individual investigation.

Economics 102 is given also during the first semester.

Economics 101 is given also during the second semester.

Note: In 1921-22 Economics 101-102 will be given in special sections for Junior and Senior Engineers.

The following courses will be open during 1921-22 only, to Engineering Seniors who have not had Economics 101-102:

105. Public Utilities. Two credit hours. First semester. Two recitations each week. Prerequisite, Economics 101-102. Mr. Hoagland.

Municipal and interurban utilities other than steam railroads. Their development and the demand for their services, with especial reference to their economic and social significance. Current tendencies in regulation and municipal ownership.

107-108. Factory Organization and Management. Three credit hours. The year. Prerequisites, Economics 101-102 and Economics 172; or credit for three full years of work in the College of Engineering, including Economics 130. May be taken concurrently with Economics 172 or 130 in 1921-22. Mr. Fisher.

The organization, operation and control of manufactures. History, literature and theory of industrial management. Plant location. Kind and development of industrial organizations. Purchase, control, and handling of materials. Production control. Routing, including arrangement and standardization of equipment and tools. Employment. Plant welfare. Systems of wage payment. Correlation of problems in this and other courses from the point of view of the manufacturing executive.

Students will be required to do field work in visiting and inspecting plants and in writing constructive reports and theses. Some expenditure may be incurred in doing this work.

109. Principles of Salesmanship. Three credit hours. First semester. Prerequisite, Economics 101-102. Mr. Sembower.

The role of salesman in modern business; relation of salesmanship and advertising; analyzing the goods, the market, and the customer for advertising and selling campaigns; sales equipment, sales records and test of efficiency; essential qualifications of a salesman in various types of manufacturing and wholesale and retail institutions; choosing, training, organizing and supervising salesmen; special types of salesmen; ethics of salesmanship.

149-150. Business Law. Three credit hours. The year. Prerequisite, Economics 101-102. Mr. Pike.

This course is intended for those who are contemplating a career in business and not in law. A study of the leading principles of interest to the business man, to be found in the law of contracts, sales, negotiable instruments, agency, partnership, corporation, etc.

Economics 149 is given also during the second semester.

Economics 150 is given also during the first semester.

163. Corporation Economics. Three credit hours. Either semester. Prerequisite, Economics 101-102. Mr. Hoagland.

The various forms of business enterprises, partnerships, joint-stock companies and corporations. Corporation organization and finance. Publicity of accounts and government regulation of corporations.

167. Transportation Economics. Three credit hours. Either semester. Prerequisite, Economics 101-102. Mr. Hoagland.

Nature of transportation economics. Development of the means of transportation, especially canals, highways, steam and electric railways and ocean routes. American railway growth and consolidation. Development of public control and the interest in government ownership.

177. Economic Statistics. Three credit hours. First semester. Prerequisite, Economics 101-102.

A study of the methods of statistical investigation. Collecting, arranging, and interpreting statistical data. Making schedules; tabulation; averages and ratios; index numbers; diagrams and curves; sampling.

178. Business Statistics. Three credit hours. Second semester. Prerequisite, Economics 177.

The application of statistical methods to economics and business research in the fields of prices, wages and income, production, trade and transportation, sales and advertising and business management.

113. Office Organization and Management. Three credit hours. Either semester. Prerequisite, Economics 101-102; or permission of the instructor. Mr. Fisher.

Administration of offices. Methods of pay. Office manager. Standards, tools, forms, equipment, office machinery. Standard methods. Files, ticklers, mail handling, dictation, messengers. Thesis or problem.

130. Cost Accumulation and Analysis. Three credit hours. Second semester. Prerequisite, credit for two full years of work in the College of Engineering. Required of Engineers before taking Economics 107-108. Open to Juniors or Seniors. Mr. Fisher.

Deals with methods of accumulating direct and indirect cost data, the determination of the proper burden factor, the analysis of the resulting figures for engineers and executives, and balancing these figures with books of account. Deals with various reports and their practical use in increasing business efficiency.

ELECTRICAL ENGINEERING

Office, 171 Robinson Laboratory

PROFESSORS CALDWELL AND WRIGHT, ASSISTANT PROFESSORS
BROWN AND PUCHSTEIN, MR. SHEPARDSON, AND
DEPARTMENT ASSISTANTS

101. **Electrical Engineering.** Five credit hours. First semester. Three lectures and four laboratory hours each week. Chemical and Mechanical Engineering, fourth year. Prerequisite, Physics 112 or Physics 114. Mr. Shepardson.

Lectures and laboratory work on direct and alternating current circuits, dynamo machinery, transformers, accumulators, and their applications.

103. **Electrical Engineering.** Three credit hours. First semester. Two lectures and three laboratory hours each week. Metallurgical and Mine Engineering, fourth year; Civil Engineering (Civil Engineering group), fourth year, alternate with Civil Engineering 125 and Civil Engineering 141. Prerequisite, Physics 112 or 125. Mr. Wright.

Recitations and laboratory work on electrical machinery, circuits and transmission.

104. **Direct Current Machinery.** Five credit hours. Second semester. Three lectures and four laboratory hours each week. Electrical Engineering, third year. Prerequisites, Physics 135, Mathematics 142, and Mechanics 101. Mr. Shepardson.

Generators and motors: a study of their theory, construction and operation. Lectures, recitations, problems and laboratory.

106. **Applications of Electricity.** One and one-half credit hours. Second semester. Three lectures each week for one-half semester. Electrical Engineering, third year. Prerequisites, Physics 135 and Mathematics 142. Mr. Caldwell and others.

A brief treatment of the use of electricity in illumination, railways, telephones, radio, mining, etc.

108. **Alternating Current Circuits and Machinery.** One and one-half credit hours. Three lectures each week for first half of second semester. Electrical Engineering, third year. Prerequisites, Mathematics 142, Physics 135, Mechanics 101; concurrent, Electrical Engineering 104. Mr. Caldwell.

Elementary treatment of circuits and equipment.

109. Alternating Current Machinery. Three credit hours. First semester. A continuation of Electrical Engineering 108. Three lectures each week. Electrical Engineering, fourth year. Prerequisite, Electrical Engineering 108; concurrent, Electrical Engineering 111. Mr. Caldwell.

Advanced treatment of transformers, synchronous motors, induction motors, etc.

111-112. Alternating Current Laboratory. Three credit hours. The year. Electrical Engineering, fourth year. Prerequisite, Electrical Engineering 108; concurrent, Electrical Engineering 109. Mr. Brown.

Alternating current apparatus and accumulators.

113. Electric Railways. Three credit hours. First semester. Two recitations and three laboratory hours each week. Electrical Engineering, fourth year, alternative with Electrical Engineering 115, 117, and 119. Prerequisite, Electrical Engineering 104; concurrent, Electrical Engineering 109. Mr. Shepardson.

Systems, apparatus, and railway operation.

115. Telephony. Three credit hours. First semester. Two recitations and three laboratory hours each week. Electrical Engineering, fourth year, alternative with Electrical Engineering 113, 117, and 119. Mr. Wright.

Methods of telephone operation, simple circuits, apparatus and elements of transmission theory.

117. Electric Illumination. Two or three credit hours. First semester. Two recitations and three laboratory hours each week. Electrical Engineering, fourth year, three credit hours, alternative with Electrical Engineering 113, 115, and 119; Architectural Engineering, third year, two credit hours. Prerequisite, Physics 118 or 132. Mr. Caldwell.

Principles of illumination, electric light sources, etc.

119. Wireless Telegraphy. Three credit hours. First semester. Two recitations and three laboratory hours each week. Electrical Engineering, fourth year, alternative with Electrical Engineering 113, 115, and 117. Mr. Brown.

Elementary theory, production, transmission, and detection of damped and undamped oscillations.

121. Electrical Design. Three credit hours. First semester. Two three-hour drawing periods each week. Electrical Engineering, fourth year. Prerequisite, Electrical Engineering 104. Mr. Puchstein.

Design of direct current dynamos, transformers, etc.

122. Electrical Design. Two credit hours. Second semester. A continuation of Electrical Engineering 121. One four-hour drawing period each week. Electrical Engineering, fourth year, elective. Mr. Puchstein.

Alternating current apparatus.

124. Electrical Transmission and Distribution. Three credit hours. Second semester. Three lectures each week. Electrical Engineering, fourth year. Prerequisites, Electrical Engineering 109. Mr. Caldwell.

Transmission and distribution systems, apparatus, organization and operation.

125-126. Special Reading and Laboratory. Credit hours to be arranged. The year. Elective for fourth year Electrical Engineering and graduate students with the consent of the instructor in charge. Prerequisites, Electrical Engineering 104 and 108. Mr. Caldwell, Mr. Puchstein, Mr. Wright, Mr. Brown.

127. Thesis. One credit hour. First semester. Electrical Engineering, fourth year. Prerequisites, Electrical Engineering 104 and 108.

128. Thesis. Five credit hours. Second semester. Electrical Engineering, fourth year.

130. Inspection Trip. Electrical Engineering, fourth year. Prerequisite, Mechanics 102.

Includes Pittsburgh, Buffalo, Niagara, and Cleveland. The entire expense need not exceed $60. A satisfactory written report on the work of the trip and an examination are required.

134. Reading Course. Electrical Engineering, fourth year. This may be taken as a substitute for Electrical Engineering 130 on presentation of reasons satisfactory to the head of the department.

Assigned reading on processes of manufacture and power plants.

132. Inspection Trip to the West. April 30th to May 5th, 1923. Required in Electrical Engineering, third and fourth years. Given only in odd years.

Includes Chicago, Milwaukee, Gary, and possibly other places. The entire expense need not exceed $60. A satisfactory written report upon the work of the trip and an examination are required.

136. Reading Course. Electrical Engineering, third or fourth year. April 30th to May 5th, 1923. A written report on assigned reading upon processes of manufacture and power plants. This may be taken as a substitute for Electrical Engineering 132 on presentation of reasons satisfactory to the head of the department.

138. Advanced Laboratory. Two credit hours. Second semester. One four-hour laboratory period. Electrical Engineering, fourth year, elective. Mr. Caldwell.

Selected tests on alternating current, apparatus, illumination, railways, etc.

139. Experience in Practice. Eight weeks during any summer vacation. Electrical Engineering.

The student shall present a satisfactory report upon the work done. This report shall include a discussion of the student's observations upon the human aspects of the work with which he was connected. The occupation, the work done, and the report shall be subject to approval by the Department of Electrical Engineering. If a student has had not less than twelve months of satisfactory practical experience, he may be permitted to substitute a satisfactory report upon such practical work for the above requirement.

In case any student is unable to obtain an opportunity for such practical experience as will fulfill the above requirement, he may be permitted by the department to substitute eight credit hours of approved academic courses for the same. This requirement shall first go into effect with the class graduating in 1922.

140. The Application of Hyperbolic Functions to Electrical Engineering Problems. Two credit hours. Second semester. Two two-hour laboratory periods each week. Elective. Prerequisite, Electrical Engineering 109; concurrent, Electrical Engineering 124. Mr. Puchstein.

Power lines, artificial lines, intelligence transmission, current distribution in armature conductors, etc.

142. Electrical Equipment. Two credit hours. Second semester. Two recitations each week. Metallurgical and Mine Engineering, fourth year. Prerequisite, Electrical Engineering 103. Mr. Wright.

Recitations and problems on the layout and cost of electrical equipment.

FOR GRADUATES

201-202. Advanced Alternating Current Machinery.

203-204. Transient Electrical Phenomena.

205-206. Advanced Alternating Current Dynamo Laboratory.

207-208. Research Work.

For description of graduate courses in this department see the Bulletin of the Graduate School.

ENGINEERING DRAWING

Office, 204 Brown Hall

PROFESSORS FRENCH AND MEIKLEJOHN, ASSISTANT PROFESSORS WILLIAMS, TURNBULL, AND SVENSEN, MR. FIELD, MR. PAFFENBARGER, MR. YERGES, AND DEPARTMENT ASSISTANTS

101. Elementary Mechanical Drawing. Two credit hours. Either semester. All four-year courses, first year. Mr. French and department assistants.

Practice in the use of drawing instruments, elementary projections.

102. Mechanical Drawing. Three credit hours. Either semester. All four-year courses, first year. Prerequisite, Engineering Drawing 101. Mr. French and department assistants.

Lettering, orthographic, isometric and oblique projections.

103. Descriptive Geometry. Three credit hours. First semester. Two recitations, one drawing period each week. Ceramic, Chemical, Electrical, General, Mechanical, Metallurgical, and Mine Engineering, second year. Prerequisite, Engineering Drawing 102. Mr. French and department assistants.

104. Machine Drawing. Three credit hours. Second semester. One lecture, two drawing periods each week. Ceramic, Chemical, General and Mechanical Engineering, second year. Prerequisite, Engineering Drawing 103. Mr. Williams, Mr. Svensen.

105. Descriptive Geometry. Three credit hours. First semester. Two lectures, one drawing period each week. Civil Engineering, second year. Prerequisite, Engineering Drawing 102. Mr. Turnbull.

106. Advanced Descriptive Geometry. Three credit hours. Second semester. Two lectures, one drawing period each week. Civil Engineering, second year. Prerequisite, Engineering Drawing 105. Mr. Turnbull.

107. Descriptive Geometry. Three credit hours. First semester. Two recitations, one drawing period each week. Architecture and Architectural Engineering, second year. Prerequisite, Engineering Drawing 102. Mr. Meiklejohn.

110. Technical Drawing. Two credit hours. Second semester. Electrical Engineering, second year. Prerequisite, Engineering Drawing 103. Mr. Williams, Mr. Svensen.

111. Technical Drawing. Two credit hours. First semester. Electrical and Mechanical Engineering, third year. Prerequisite, Engineering Drawing 104 or 110. Mr. Williams, Mr. Svensen.

121-122. Technical Drawing. Two credit hours. The year. Chemical Engineering, third year. Prerequisite, Engineering Drawing 104. Mr. Svensen.

Designing of chemical plants and machinery.

ENGLISH

Office, 103 Physics Building

PROFESSORS DENNEY AND BECK, MR. CRAIG, MISS SNIFFEN,
MISS HARBARGER, MISS PEGG, MISS ROBINSON,
AND DEPARTMENT ASSISTANTS

101. Paragraph Writing: Description and Narration. Two credit hours. Either semester. All instructors.

English 101 is given also in the Summer Session.

104. Paragraph Writing: Exposition and Argumentation. Two credit hours. Either semester. Prerequisite, English 101. All instructors.

English 104 is given also in the Summer Session.

119. Advanced English for Engineers. Three credit hours. Either semester. Elective. Prerequisites, English 101 and 104. Miss Harbarger.

Training in English for practical and professional writing. Emphasis is put upon the business letter and the general engineering report.

FRENCH

(See Romance Languages and Literatures)

GEOLOGY

Office, 104 Orton Hall

PROFESSORS BOWNOCKER AND CARMAN, ASSISTANT PROFESSOR PEATTIE, MISS MORNINGSTAR, MR. LAMBORN, MR. WEBB, AND DEPARTMENT ASSISTANTS

160. General Geology. Five credit hours. Second semester. Four recitations and two laboratory hours each week. Mine Engineering, second year. Mr. Bownocker.

The applications of the principles of geology to Mine Engineering. Petrographical, structural and dynamical geology with a brief course in historical geology. The laboratory work consists of a study of rocks in hand specimens and geological folios.

Occasional field trips on Saturdays.

167. Economic Geology. Three credit hours. First semester. Three recitations each week. Mine Engineering, fourth year. Prerequisites, Geology 165 and 166. Mr. Bownocker.

A study is made of the nature of ores, their classification and origin; the metallic ores in the United States, their distribution, abundance, modes of occurrence and origin. The coals of the Appalachian field.

168. Geology. Three credit hours. Either semester. Two recitations and two laboratory hours each week. Metallurgical Engineering, second year; Ceramic and Civil Engineering, third year. Mr. Bownocker, Mr. Carman.

During part of the semester, field trips will be taken on Saturday.

The application of the principles of geology to Engineering. The study of the common rock-forming minerals and rocks, structural geology, dynamic geology and a briefer consideration of physiographic, historical and economic geology.

FOR GRADUATES

201-202. Advanced Historical Geology.

203-204. Research Work.

For description of graduate courses in this department see the Bulletin of the Graduate School.

GERMAN

Office, 317 University Hall

PROFESSORS EVANS, EISENLOHR AND BLOOMFIELD,
ASSISTANT PROFESSOR THOMAS

101-102. Elementary German. Four credit hours. The year. Open to students in any four-year course who enter with a foreign language other than German. All instructors.

The essentials of grammar and oral practice, first semester.

Reading of easy narrative, grammatical drill, second semester.

German 101 is given also during the second semester.

German 102 is given also during the first semester.

103. Intermediate German. Four credit hours. Either semester. Prerequisite, German 102 or two entrance units in German. Not open to students who enter with four entrance units in German. All instructors.

Reading of narrative prose; grammar review; prose composition. One hour prose composition each week.

German 103 is given also during the second semester.

106. Science Reading. Four credit hours. Second semester. This course is for Engineering students; a continuation of German 103 and 107.

Rapid reading of technical literature. This is preceded or accompanied by drill on word formation, word compounds, sentence structure. The object of the course is to enable the student to read German technical literature.

107. Advanced German. Four credit hours. First semester. Open to first-year students who enter with four entrance units in German. By agreement with the College of Engineering, students may, on securing permission, continue this course in the second semester in place of 106.

MATHEMATICS

Office, 314 University Hall

PROFESSORS BOHANNAN, McCOARD, SWARTZEL, KUHN, RASOR, AND MORRIS, ASSOCIATE PROFESSOR ARNOLD, ASSISTANT PROFESSORS PRESTON, BAREIS, RIETZ, WEAVER, AND BEATTY, MISS RICKARD, MR. CARIS

100. Algebra. Five credit hours. First semester. This course to be taken by students entering with one-half unit entrance condition in algebra.

131. College Algebra and Trigonometry. Five credit hours. Either semester. All four-year courses in Engineering, first year. Prerequisite, entrance algebra and geometry. All instructors.

132. Plane Trigonometry and Analytical Geometry. Five credit hours. Either semester. All four-year courses in Engineering, first year. Prerequisite, Mathematics 131. All instructors.

This course is given also in the Summer Session.

141. Calculus. Five credit hours. Either semester. All four-year courses in Engineering except Architecture, second year. Prerequisite, Mathematics 132. All instructors.

142. Calculus. Five credit hours. Either semester. Continuation of Mathematics 141. All four-year courses in Engineering except Architecture, second year. Prerequisite, Mathematics 141. All instructors.

This course is given also in the Summer Session

127-128. Analytical Geometry and Calculus. Three credit hours. The year. Architecture, second year. Prerequisite, Mathematics 132.

FOR ADVANCED UNDERGRADUATES AND GRADUATES

Prerequisite: Differential and Integral Calculus.

163-164. Plane and Solid Analytical Geometry. Three credit hours. The year. Miss Bareis.

167-168. Differential Equations. Three credit hours. The year. Mr. Bohannan.

173-174. Modern Higher Algebra. Three credit hours. The year. Mr. Kuhn.

FOR GRADUATES

201-202. Theory of Functions of a Complex Variable.

203. Fourier's Series and Spherical Harmonics.

204. Vector Analysis and its Applications.

205-206. Calculus of Variations.

207. History of Mathematics.

209-210. Theory of Statistics.

211-212. Groups.

213-214. Differential Geometry.

215-216. Functions of a Real Variable.

217-218. Infinite Series and Products.

219-220. Theory of Numbers.

221-222. Theory of Invariants.

For description of graduate courses in this department see the Bulletin of the Graduate School.

MECHANICAL ENGINEERING

Office, 244 Robinson Laboratory

PROFESSORS MAGRUDER, MARQUIS, NORMAN, AND JUDD, ASSISTANT PROFESSOR BROWN, MR. BUCHER, MR. STINSON, AND DEPARTMENT ASSISTANTS

101. Mechanism and Machine Design. Three credit hours. First semester. Three recitations each week. Electrical Engineering, third year. Prerequisites, Engineering Drawing 103 and Physics 114. Mr. Stinson.

Recitations on the principles of mechanism and machine design.

103. Steam Power Plants. Three credit hours. First semester. Three recitations each week. Mechanical Engineering, third year. Prerequisites, Engineering Drawing 104 and Physics 119; concurrent, Mechanics 101 and Metallurgy 117 and 119. Mr. Marquis, Mr. Brown.

A descriptive and analytical study of steam-generating and steam-using machinery.

104. Steam Power Plants. Four credit hours. Second semester. Four recitations each week. Mechanical Engineering, third year. Prerequisites, Mechanical Engineering 103 and Metallurgy 117 and 119; concurrent, Mechanics 102. Mr. Marquis, Mr. Brown.

A continuation of Mechanical Engineering 103.

105-106. Heat Power Engineering. Three credit hours. The year. Three recitations each week. Electrical Engineering, third year. Prerequisites, Engineering Drawing 110 and Physics 114; concurrent, Mechanics 101 and 102. Mr. Magruder.

A descriptive and analytical study of steam-generating and steam-using machinery, gas and oil engines.

107. Steam Engineering. Three credit hours. First semester. Three recitations each week. Chemical Engineering, third year. Prerequisites, Engineering Drawing 104 and Physics 112. Mr. Bucher.

An elementary descriptive and analytical study of steam-generating and steam-using machinery.

110. Mechanism and Machine Design. Three credit hours. Second semester. Three recitations each week. Ceramic Engineering, third year. Prerequisites, Engineering Drawing 104, Mechanics 101. Mr. Stinson.

Recitations on the principles of mechanism, mechanical movements, elementary machine design, and power plants.

112. Machine Design. Two credit hours. Second semester. Two recitations each week. Electrical Engineering, fourth year. Prerequisites, Mechanics 102 and Engineering Drawing 111. Mr. Norman.

Practical application of the principles of machine design.

114. Mechanism. Three credit hours. Second semester. Three recitations each week. Mechanical Engineering, third year. Prerequisites, Engineering Drawing 104, Physics 119. Mr. Stinson.

Recitations and practice on the principles of mechanism and mechanical movements.

116. **Mechanism Drawing.** One credit hour. Second semester. One three-hour drawing period each week. Mechanical Engineering, third year. Prerequisite or concurrent, Mechanical Engineering 114. Mr. Stinson.

Practice in laying out mechanisms and mechanical movements.

121. **Heating and Ventilating.** Three credit hours. First semester. Three recitations each week. Architecture and Architectural Engineering, fourth year. Prerequisites, Mechanics 103, Physics 112 or 118. Mr. Brown.

Recitations and lectures on the principles and methods of heating and ventilation.

123. **Materials of Construction.** Two credit hours. First semester. One recitation and three laboratory hours each week. Architectural Engineering, third year. Concurrent, Mechanics 103. Mr. Judd.

Lectures and recitations on the materials used in architectural and building construction, and laboratory exercises on their properties.

125. **Gas Engines and Producers.** Two credit hours. First semester. Two recitations each week. Mechanical Engineering, fourth year. Prerequisite, Mechanical Engineering 104, or 106, or 107. Mr. Magruder.

A study of gas engines and of gas producers as used for power purposes.

127. **Machine Design.** Five credit hours. First semester. Five recitations each week. Chemical and Mechanical Engineering, fourth year. Prerequisites, Engineering Drawing 104 and 111, Mechancis 101, Metallurgy 117 and 119, Mechanical Engineering 103 or 107. Mr. Norman.

A detailed course of study based upon mechanics and the materials of construction applied to the design and construction of machinery.

129. Thermodynamics. Two credit hours. First semester. Two recitations each week. Mechanical Engineering, fourth year. Prerequisite, Mechanical Engineering 104. Mr. Magruder.

The transmutations of heat and mechanical energies in steam and air engines, in air and ammonia compressors, and in refrigeration machines, together with a study of the tests of ideal and actual engines and of their indicator diagrams; the flow of gases through pipes and orifices.

130. Inspection Trip to the East. May 1st to 6th, 1922. Required in Mechanical Engineering, third and fourth years. Given only in even years. Prerequisite or concurrent, Mechanical Engineering 104.

Includes Pittsburgh, Buffalo, Niagara Falls, Cleveland, and possibly other places. The entire expense need not exceed $60. A satisfactory written report upon the work of the trip and examination are required.

134. Reading Course. Mechanical Engineering, third and fourth years. May 1st to 6th, 1922. A written report on assigned reading upon processes of manufacture and power plants. This may be taken as a substitute for Mechanical Engineering 130 on presentation of reasons satisfactory to the head of the department.

132. Inspection Trip to the West. April 30th to May 5th, 1923. Required in Mechanical Engineering, third and fourth years. Given only in odd years. Prerequisite or concurrent, Mechanical Engineering 104.

Includes Chicago, Milwaukee, Gary, and possibly other places. The entire expense need not exceed $60. A satisfactory written report upon the work of the trip and an examination are required.

136. Reading Course. Mechanical Engineering, third and fourth years. April 30th to May 5th, 1923. A written report on assigned reading upon processes of manufacture and power plants. This may be taken as a substitute for Mechanical Engineering 132 on presentation of reasons satisfactory to the head of the department.

139. Practical Experience in a Mechanical Engineering Industry. Eight weeks during the second or third summer vacation and before beginning the work of the fourth year. Mechanical Engineering. The student shall present a satisfactory report upon the work done. This report shall include a discussion of the student's observations upon the human and industrial aspects of the work with which he was connected, process of manufacture, and other observed data worthy of record. The occupation, the work done, and the report shall be subject to the approval of the head of the department. If a student has had twelve months, or more, of satisfactory practical experience, he may be permitted to substitute a satisfactory report upon the work so done for the above requirement. In case a student is unable to obtain an opportunity to get such practical experience as will fulfill the above requirements, he may be permitted by the department to substitute eight credit hours of approved courses for the same. This requirement shall first go into effect with the class graduating in 1923.

142. Hydraulic Machinery. Two credit hours. Second semester. Two recitations each week. Elective in Civil Engineering (Civil Engineering group), fourth year; Mechanical Engineering, fourth year. Prerequisites, Mechanics 102, Mechanical Engineering 104 or 107, or 127, or 173. Mr. Judd.

A study of pumping machinery.

144. Machine Design. Five credit hours. Second semester. Three recitations and two three-hour drawing periods each week. Chemical and Mechanical Engineering, fourth year. Prerequisite, Mechanical Engineering 127. Mr. Norman.

A continuation of Mechanical Engineering 127, with practical applications on the drawing board of the principles to the design of some particular machine.

146. Steam Turbines. Two credit hours. Second semester. Two recitations each week. Optional in Mechanical Engineering with Mechanical Engineering 150, fourth year. Prerequisite, Mechanical Engineering 129. Mr. Marquis.

A study of the generation of power by steam turbines, including auxiliary machinery.

148. Thesis Work. Three credit hours. Second semester. Mechanical Engineering, fourth year. Prerequisite, Mechanical

Engineering 125, 127, 129, and 179. Mr. Magruder, Mr. Marquis, Mr. Judd, Mr. Brown.

A special investigation or design based upon the work of the courses.

150. **Hydraulic Power.** Three credit hours. Second semester Two recitations and three laboratory hours each week. Elective in Civil Engineering (Civil Engineering group), and optional in Mechanical Engineering, fourth year. Prerequisites, Mechanical Engineering 173, 175, or 179. Mr. Judd.

A study of hydraulic turbines and the generation of hydraulic power.

160. **Experimental Engineering Laboratory.** Two credit hours. Second semester. Four laboratory hours each week. Electrical Engineering, third year. Concurrent, Mechanics 102 and Mechanical Engineering 106. Mr. Bucher and instructors.

Calibration of pressure gauges and indicator springs; steam engine indicator practice; testing of lubricating oils and the materials of construction.

164. **Experimental Engineering Laboratory.** Two credit hours. Second semester. Four laboratory hours each week. Mechanical Engineering, third year. Concurrent, Mechanics 102 and Mechanical Engineering 104. Mr. Brown, Mr. Bucher.

Calibration of pressure gauges and indicator springs; steam engine indicator practice; testing of oils and materials of construction.

169. **Experimental Engineering Laboratory.** Two credit hours. First semester. Four laboratory hours each week. Architectural Engineering, fourth year. Concurrent, Mechanical Engineering 121. Mr. Marquis, Mr. Brown.

Investigations of the heating and ventilating plants of different buildings, lay-outs, and laboratory tests of equipments used in such plants.

171. **Experimental Engineering Laboratory.** Three credit hours. First semester. One recitation and four laboratory hours each week. Elective. Prerequisites, Mechanics 101 and 102 or 104. Mr. Judd.

Selected laboratory exercises in the testing of lubricants and the materials of construction; calibration of pressure gauges and indicator springs; steam engine indicator practice; and brake tests of steam engines.

173. Experimental Engineering Laboratory. Five credit hours. First semester. Two recitations and six laboratory hours each week. Civil Engineering, fourth year. Prerequisite, Mechanics 102. Mr. Marquis, Mr. Judd, Mr. Bucher.

Practice in the testing of the materials of construction; calibration of orifices and weirs; study of the flow of liquids and gases; tests of steam, power, rotary, and centrifugal pumps, tests of water motors and turbine water wheels. Lectures and recitations on same and on steam engines, boilers, and transmission machinery.

175. Experimental Engineering Laboratory. Three credit hours. First semester. Six laboratory hours each week. Electrical Engineering, fourth year. Prerequisites, Mechanical Engineering 106 and 160. Mr. Marquis, Mr. Judd, Mr. Brown, Mr. Bucher.

Tests of steam engines and boilers, of gas and oil engines, and of steam and power pumps; hydraulic experimentation; and the use of transmission and absorption dynamometers.

179. Experimental Engineering Laboratory. Two credit hours. First semester. Four laboratory hours each week. Mechanical Engineering, fourth year. Prerequisite, Mechanical Engineering 164; concurrent, Mechanical Engineering 125 and 129. Mr. Marquis, Mr. Judd, Mr. Brown, Mr. Bucher.

Valve setting, moisture determinations in steam, gas calorimetry, measurements of flow of water by means of orifices, nozzles, weirs, and venturimeter; tests of belts with use of transmission and absorption dynamometers.

190. Experimental Engineering Laboratory. Six credit hours. Second semester. Twelve laboratory hours each week. Mechanical Engineering, fourth year. Prerequisites, Mechanical Engineering 125, 129, and 179. Mr. Marquis, Mr. Judd, Mr. Bucher.

Tests of steam and hot-air engines; steam boilers; gas and oil engines; gas producers; air compressors; injectors and pulsometers; centrifugal, rotary, and power pumps; hydraulic rams, impulse and turbine water wheels; fans and blowers, and steam turbines.

191. Experimental Engineering Laboratory. Four credit hours. First semester. Two recitations and four laboratory hours each week. Metallurgical and Mine Engineering, fourth year. Prerequisites, Mechanics 102 and Metallurgy 112. Mr. Judd, Mr. Bucher.

Lectures and recitations on steam and gas engines, steam boilers and gas producers. Laboratory work in the calibration of pressure gauges and indicator springs; valve setting; testing of steam engines; testing of steam and centrifugal pumps and centrifugal fans; boiler and fuel tests; tests of gas engines and gas producers.

FOR GRADUATES

201-202. Research Work.

203-204. Gas Power and Design.

205-206. Gas Power Laboratory Work.

207-208. Steam Power Plant Economics and Design.

209. The Steam Locomotive.

For description of graduate courses in this department see the Bulletin of the Graduate School.

MECHANICS

Office, 219 Lord Hall

PROFESSORS BOYD AND CODDINGTON, MR. OTT

The laboratory work in strength of materials, involving the use of testing machines, is given at present in the Department of Mechanical Engineering.

101. Statics and Strength of Materials. Five credit hours. First semester. Architectural, Ceramic, Chemical, Civil, Electrical, Mechanical, Metallurgical and Mine Engineering, third year. Prerequisite, Mathematics 142. Mr. Boyd, Mr. Coddington.

102. Strength of Materials: Kinetics and Hydraulics. Five credit hours. Second semester. Chemical, Civil, Electrical, Mechanical, Metallurgical, and Mine Engineering, third year. Prerequisite, Mechanics 101. Mr. Boyd, Mr. Coddington.

103. Statics and Strength of Materials. Five credit hours. First semester. Architecture, third year. Prerequisite, Mathematics 128 or 142. Mr. Boyd.

104. Strength of Materials. Two credit hours. Second semester. Architectural and Ceramic Engineering, third year. Prerequisite, Mechanics 101. Mr. Boyd.

FOR GRADUATES

201-202. Advanced Theoretical Mechanics.

For description of graduate courses in this department see the Bulletin of the Graduate School.

METALLURGY

Office, 100 Lord Hall

PROFESSOR DEMOREST, ASSISTANT PROFESSOR MUELLER

105. Fire Assaying. Two credit hours. First semester. Metallurgical Engineering, third year; Mine Engineering, fourth year. One lecture and laboratory each week throughout the semester. Prerequisite, Metallurgy 106 or equivalent. Mr. Mueller.

Lectures and laboratory work, practical work in the assaying of gold, silver ores and bullion.

106. Metallurgical Analysis. Three or four credit hours. First semester. Metallurgical and Mine Engineering, second year. One lecture and six or nine laboratory hours each week. Prerequisite, Chemistry 106 or 110. Mr. Demorest.

Lectures and laboratory work. Laboratory work in the analysis of iron ores, iron and steel, slags, and ores of lead, zinc, and copper by wet methods, using the approved methods as practiced in technical laboratories and metallurgical works.

107. Alloy Analysis. Three credit hours. Either semester. One lecture, laboratory two afternoons each week during the semester. Metallurgical Engineering, second year; Mine Engineering, third year. Prerequisite, Metallurgy 106. Mr. Demorest.

Lectures and laboratory work. Laboratory work in the analysis of alloy steels, such as vanadium, tungsten, chromium, nickel, and molybdenum steels and brasses, babbitts, and other alloys.

110. General Metallurgy of Non-Ferrous Metals. Four credit hours. Second semester. Four recitations each week throughout the semester. Metallurgical and Mine Engineering, third year. Prerequisites, Metallurgy 117, Mineralogy 102. Mr. Mueller.

Lectures and recitations on the metallurgy and properties of the non-ferrous metals: copper, lead, gold, silver, zinc, aluminum, tin, antimony, etc. Special attention is given to electro-metallurgy and hydro-metallurgy.

112. Technical Gas and Fuel Analysis. Two or three credit hours. Second semester. Metallurgical Engineering, third year; Mine Engineering, fourth year. Two afternoons each week. Prerequisites, Metallurgy 106 and 117 or equivalent. Mr. Mueller.

Laboratory work supplemented by lectures and problems. Technical analysis of metallurgical and mine gases and coal. Determination of heating values of coal, oils and gas. Problems involving the application of gas analysis to furnace operation and mine ventilation.

113. Ore Dressing and Coal Washing. Four credit hours. Second semester. Two lectures and one laboratory period each week. Metallurgical Engineering, fourth year; Mine Engineering, third year. Prerequisites, Metallurgy 117 and 119.

Methods of concentrating and enriching ores and fuels by mechanical means. Lectures with reference to standard books and various papers in technical journals.

117. Fuel. Two credit hours. First semester. Two recitations each week during the semester. Chemical, Mechanical, Metallurgical and Mine Engineering, third year; Ceramic Engineering, fourth year. Prerequisites, Chemistry 106 or 110, Physics 112 or 114. Mr. Demorest.

Lectures, recitations and problems on fuels, their properties, uses and manufacture.

119. Iron and Steel. Two credit hours. First semester. Two recitations each week during the semester. Chemical, Mechanical, Metallurgical and Mine Engineering, third year. Prerequisites, Chemistry 106 or 110, Physics 112 or equivalent. Mr. Demorest, Mr. Mueller.

Lectures, recitations and problems on the general metallurgy of iron and steel, including their properties and the processes of smelting, refining, shaping and heat treating used in modern plants.

120. Metallography. Two credit hours. Second semester. One lecture and three laboratory hours each week during the semester. Metallurgical Engineering, third year. Prerequisites, Metallurgy 107, 106, 119 or equivalent.

The study of freezing and cooling curves, equilibrium diagrams and their meaning, changes of structure in the solid state of pure metals and alloys, such as copper, steel, brass and bronze. Microscopic examination of commercial and metallurgical products.

123. Metallography. Three credit hours. First semester. Elective. One lecture and four laboratory hours each week. Prerequisites, Metallurgy 106, 107, 119 or equivalent. Mr. Demorest.

The study of freezing and cooling curves, equilibrium diagrams and their meaning, changes of structure in the solid state of pure metals and alloys, such as copper, steel, brass and bronze. Microscopic examination of commercial and metallurgical products and methods of metallographic research.

125. Pyrometry. One credit hour. First semester. Three laboratory hours each week. Ceramic Engineering, third year. Mr. Demorest.

Exercises in the measurement of high temperature by standard pyrometric methods using nobel and base metals, thermo-couples with galvanometer and potentiometer indicators, optical and radiation pyrometers and resistance thermometers and the calibration of pyrometers.

127. Metallurgical Construction. Four credit hours. First semester. Metallurgical Engineering, fourth year. Recitations, lectures and drawing-room practice. Prerequisites, Metallurgy 117, 119, 110, and 112. Mr. Mueller.

Lectures, recitations and drawing-room practice on the principles, practice and design of mill lay-outs and furnace construction with special attention given to refractories.

128. Metallurgical Construction. Four credit hours. Second semester. Metallurgical Engineering, fourth year. Continuation of Metallurgy 127. Mr. Mueller.

Lectures, recitations and drawing-room practice on the principles, practice and design of metallurgical plants, with special attention given to operation, control, costs and handling of materials.

141. Metallurgical Investigations. Three to five credit hours. First semester. Prerequisites, one year of quantitative analysis, college physics, and not less than one semester of general metallurgy. Mr. Demorest.

(a) Iron, Steel and Other Alloys. Investigations on the composition, properties, structure, and heat treatment. Prerequisites, Metallurgy 119, 133.

(b) Fuels. Investigations on composition, conservation and utilization. Prerequisite, Metallurgy 117.

(c) Investigations on the Metallurgy and Analysis of the Less Common Metals, as tin, antimony, bismuth, tungsten, etc. Prerequisite, Metallurgy 107.

(d) Investigation of Special Metallurgy Processes, as the electrolytic refining of lead, etc. Prerequisite, Metallurgy 110.

116. Thesis. Three credit hours. Second semester. Metallurgical Engineering, fourth year.

130. Inspection Trip. Second semester. Metallurgical Engineering, third year.

131. Fuel Analysis and Calorimetry. One credit hour. First semester. Mechanical Engineering, third year. Prerequisites, Chemistry 106 or 110, Physics 113 and 119.

Laboratory work supplemented by lectures. The technical analysis of coal and fuel gas. Determination of calorific value of coals and gases.

133. Advanced Metallography. Three or five credit hours. First semester. Metallurgical Engineering, fourth year. Prerequisite, Metallurgy 120 or 123. Mr. Demorest.

Advanced instruction in metallographic technique applied to ferrous and non-ferrous alloys.

134. Advanced Metallography. Three to five credit hours. Second semester. Metallurgical Engineering, fourth year. Prerequisite, Metallurgy 133.

The application of metallographic examination of metals and metallographic research to technical metallurgical problems.

136. Industrial Work. Four credit hours. Metallurgical Engineering, at the close of the second year. Eight weeks of approved work in a metallurgical plant. A report to be made in writing and before students.

145. Ceramic Chemistry. Four credit hours. First semester. Ceramic Engineering, second year. Prerequisite, Chemistry 106 or 110.

Quantitative analysis of limestone and simple minerals.

146. Ceramic Chemistry. Four credit hours. Second semester. Ceramic Engineering, second year. Prerequisite, Metallurgy 145.

Quantitative analysis of clays, feldspars, frits, fire-gases, etc.

MILITARY SCIENCE AND TACTICS

Office, The Barracks

LIEUT. COLONEL LEONARD, LIEUT. COLONEL CONWAY (RTD.), MAJORS McLEAN, HANFORD AND MURRAY, FIRST LIEUTENANTS BENNER, KAUFFMAN AND COX, ALL U. S. A., AND DEPARTMENT ASSISTANTS

In accordance with the Morrill Act, passed in 1862, under which the University was established, military instruction must be included in the curriculum. The Board of Trustees therefore requires all male students, both special and regular, unless excused by the Military and Gymnasium Board, to drill during two years.

The Reserve Officers' Training Corps was established under the Defense Act of June 3rd, 1916, the required two years' work being included in its four year course. Instruction is given in Infantry, Field Artillery, and Veterinary. Under ordinary circumstances this work is under eight commissioned officers, three warrant officers, and eleven non-commissioned officers of the Regular Army, detailed for the purpose.

EITHER 101-102 OR 105-106 ARE REQUIRED OF ALL FRESHMEN

101-102. Infantry. One credit hour. The year. Three hours each week. One-half theoretical and one-half practical work. An elementary course including infantry drill, close and extended order, battle formations, formations for protection in hostile countries, etc., practice with gallery rifles at any open hour, daily during the winter months. Lecture one hour each week by the President.

105-106. Field Artillery. One credit hour. The year. Three hours each week. One-half theoretical and one-half practical work. Field artillery drill, administration, ordnance and materiel. Lecture one hour each week by the President.

EITHER 103-104 OR 107-108 ARE REQUIRED OF ALL SOPHOMORES

103-104. Infantry. One credit hour. The year. Three hours each week. One-half theoretical and one-half practical work. A continuation of 101-102, with additional instruction in pistol practice, the bayonet and hand grenades.

107-108. Field Artillery. One credit hour. The year. Three hours each week. One-half theoretical and one-half practical work. Artillery, motors, topography and reconnaissance.

125-126. Advanced Military Science. For Infantry. Three credit hours. The year. Prerequisites, 101-102, 103-104, or equivalent. Five hours each week. Two hours are allotted to training as instructors in courses 101-102 or 103-104. Classroom work three hours each week in advanced minor tactics, map problems, liaison, topography, field engineering, military law, technique of automatic rifles, machine guns and infantry cannon.

135-136. Advanced Military Science. For Field Artillery. Three credit hours. The year. Prerequisites, 105-106, 107-108, or equivalent. Five hours each week. Classroom work three hours each week in field artillery, communication, gunnery, conduct of fire, tactics, care and training of horses. Practical work in horsemanship and training as instructors, two hours each week.

127-128. Advanced Military Science. For Infantry. Three credit hours. The year. Prerequisite, 125-126 or equivalent. Five hours each week. Two hours allotted to training as instructors in courses 101-102 or 103-104. Classroom work three hours each week in topography and military policy of the United States.

137-138. Advanced Military Science. For Field Artillery. Three credit hours. The year. Prerequisite, 135-136 or equivalent. Five hours each week. Classroom work three hours each week in minor tactics and map maneuvers, military policy of the United States, military history, military law, care and training of horses. Practical work in horsemanship and practice as instructors, two hours each week.

SUMMER CAMPS

As a part of the instruction of the Reserve Officers' Training Corps at the University, summer camps are conducted for this district: Infantry and Field Artillery, at Camp Knox, Kentucky, thirty-one miles from Louisville. One summer camp for the students of the first two years is held between the first and second school years. This camp is voluntary. The camp for the advanced course is held between the third and fourth years and is required. For special reasons the advanced course camp may be postponed until after the fourth year is completed.

These camps are of six weeks duration and the work is mostly practical. In addition to military work, field sports and competitions are conducted. The training for Infantry includes firing on the target range with service rifles and using ball ammunition in combat. The training for Field Artillery includes firing field guns with service ammunition. The development of leadership and discipline are primary subjects of these camps.

The Government furnishes transportation to and from the camps. While in camp, clothing, subsistence, medical attention and entertainment are provided.

MINE ENGINEERING

Office, 200 Lord Hall

PROFESSORS RAY AND NOLD

103. Mine Surveying. Four credit hours. First semester. Two recitations and two periods of field work each week. Mine Engineering, second year. Prerequisites, Engineering Drawing 102, Mathematics 132. Mr. Nold.

Recitations and field practice in the use of instruments for surface and underground surveys. Field notes are taken and maps and plans made in the drawing-room.

108. Industrial Work. Four credit hours. Mine Engineering, at the close of the second year. Prerequisites, Mine Engineering 103 and 110.

Eight weeks of approved work in a mine or mining plant.

A report of the summer's work to be made in writing and, if possible, before students.

110. Mine Trip. Second semester. Mine Engineering, second year. Prerequisite, Mine Engineering 103 or equivalent. Mr. Nold.

Two or three days' trip to Ohio coal mines. The students make a survey of a portion of the mine, and a supervised inspection is made of the mine workings. A written report covering the work of the trip is required.

113. Mine Surveying. Three credit hours. First semester. Two recitations and three hours field work each week. Ceramic Engineering, third year; Metallurgical Engineering, second year. Prerequisites, Engineering Drawing 102 and Mathematics 132. Mr. Nold.

Recitations and field practice in the use of instruments for surface and underground surveys. Field notes are taken and maps made in the drawing-room.

115. Principles of Mining. Two credit hours. First semester. Two recitations each week. Metallurgical Engineering, third year; Ceramic Engineering, fourth year. Prerequisites, Mine Engineering 113 and Geology 168. Mr. Nold.

Recitations and lectures on the principles of prospecting and mining. Particular attention is paid to the mining of materials used in ceramic industries.

116. Thesis. Three credit hours. Second semester. Mine Engineering, fourth year. Mr. Ray, Mr. Nold.

117. Mining Problems. Three credit hours. First semester. Three recitations each week. Mine Engineering, third year. Prerequisites, Mine Engineering 103 and 110. Mr. Nold.

Practice in the solution of engineering problems pertaining to mine projections, shafts, slopes, drifts for coal and metal mining.

122. Prospecting and Preliminary Operations. Three credit hours. Second semester. Three recitations each week. Mine Engineering, third year. Prerequisites, Mechanics 101, Mine Engineering 103, Geology 160 and Mine Engineernig 108. Mr. Nold.

Prospecting, boring, use of explosives, shaft sinking and tunneling.

123. Development and Methods of Mining. Three credit hours. First semester. Three lectures each week. Mine Engineering, fourth year. Prerequisites, Mechanics 102, Mine Engineering 122. Mr. Ray.

Lectures on development, locating of openings, methods of mining, supporting excavations, etc. Constant reference is required to standard works and to the leading technical journals.

124. Mine Operations. Three credit hours. Second semester. Three recitations each week. Mine Engineering, fourth year. Prerequisites, Mine Engineering 122 and 123, Electrical Engineering 103; concurrent, Mechanical Engineering 192. Mr. Nold.

Drainage, haulage, hoisting, ventilation, illumination, mine gases and explosions.

126. Mine Examinations and Reports. Three credit hours. Second semester. Three lectures each week. Mine Engineering, fourth year. Concurrent, Mine Engineering 124. Mr. Ray.

Lectures on mine examinations, estimating ore reserves, valuation, reports, organization, administration and determination of costs.

127. Mine Design. Three credit hours. First semestei One lecture and four laboratory hours each week. Mine Engineering, fourth year. Prerequisites, Mechanics 102 and Mine Engineering 122. Mr. Nold.

Design of mining plants. The student is given certain data relative to an actual or hypothetical mine, and he designs the plant lay-out and details a building.

128. Mine Design. Three credit hours. Second semester. Eight laboratory hours each week. Mine Engineering, fourth year Prerequisite, Mine Engineering 127; concurrent, Mine Engineering 124. Mr. Nold.

A continuation of the problem assigned in Mine Engineering 127. The design of mine structures and buildings. Specification writing and estimation of costs.

130. Mine Reports. Three credit hours. Second semester. Mine Engineering, fourth year. Prerequisite, Mine Engineering 123; concurrent, Mine Engineering 124 and 126.

Written reports on engineering projects and operations.

132. Inspection Trip. Second semester. Mine Engineering, third year.

Six-day inspection trip to mines or running plants in Ohio and neighboring states.

FOR GRADUATES

201-202. Research Work.

For description of graduate courses in this department see the Bulletin of the Graduate School.

MINERALOGY

Office, 104 Lord Hall

PROFESSOR McCAUGHEY

102. Crystallography and Mineralogy. Three or four credit hours. Second semester. Three lectures or three lectures and one laboratory period each week. Metallurgical and Mine Engineering, second year; Chemical Engineering, third year. Prerequisite, Chemistry 106 or 110.

Lectures on crystallography, physical and descriptive mineralogy. Illustrated by drawings, models and mineral specimens.

104. Determinative Mineralogy. Three credit hours. First semester. One lecture, six laboratory hours each week. Metallurgical and Mine Engineering, third year. Prerequisite, Mineralogy 102.

Lectures and laboratory work in practical determination of minerals by physical and chemical tests. Each student is furnished with a set of apparatus, and works under an instructor's inspection. Brush and Penfield's "Determinative Mineralogy" is used as a manual.

105. Thermo-Chemical Mineralogy. Two credit hours. First semester. Ceramic and Metallurgical Engineering, fourth year. Prerequisites, Chemistry 159, Ceramic Engineering 108 or Metallurgy 117 and 119. Mr. McCaughey.

Thermal properties of minerals, their formation and transformation in silicate mixtures.

111. Elementary Microscopic Petrography. Two credit hours. Second semester. Two three-hour laboratory periods. Mine Engineering, fourth year. Prerequisites, Geology 165, 166, Mineralogy 102. Mr. McCaughey.

Instruction and practice in the use of the petrographic microscope in the identification and study of minerals and rocks in thin sections.

121. Microscopic Mineralogy. Three to five credit hours. First semester. One lecture and four to eight laboratory hours each week. Prerequisites, Mineralogy 102 and Physics 114. Mr. McCaughey.

The use of the polarizing microscope in the identification of minerals in fine powder and in thin section. Determination of the optical constants of minerals and crystallized bodies with the polarizing microscope.

131. Mineralogical Investigations. Three to five credit hours. Either semester. Library, conference, and advanced laboratory work. Prerequisites, Mineralogy 102, 104, and 121 or 111.

(a) Advanced Crystallography. Study of the thirty-two crystal groups and their representative minerals. Laboratory practice with the two-circle goniometer in the measurement of crystals and the drawing and projection of these crystals.

(b) Microscopic Petrography. Study and investigation of igneous, metamorphic and sedimentary rocks in thin section.

(c) Soil Mineralogy. Mineralogical investigation of loose rock, such as soils, sands and clays.

(d) Applied Microscopic Mineralogy. Application of the principles of microscopic mineralogy to the determination of melting and transformation temperatures of minerals; the microscopic study of refractories, ceramic products and glasses.

PHYSICAL EDUCATION

Office, The Gymnasium

MEN

PROFESSORS ST. JOHN, WILCE, CASTLEMAN, AND NICHOLS, ASSISTANT PROFESSOR TRAUTMAN, MR. COBB, MR. HINDMAN

100-100. Hygiene. One credit hour. Either semester. Required of every Freshman during his first year of residence in the University.

This course deals with the various factors and conditions which affect the health and efficiency of the student.

101-102. Physical Education. One credit hour. The year. Two hours each week. Required of every Freshman during his first year of residence in the University.

The work in this course is based on a thorough physical examination given at the beginning of the year. The course includes body-building exercises for the relief and correction of slight bodily defects and faulty posture and gymnastic, athletic games and contests aiming to promote and foster vigorous health and to give a fundamental training which will develop motor skill, endurance, strength, self-control and self-confidence.

WOMEN

ASSISTANT PROFESSOR SCOFIELD, MISS RAYNOR-RANCK, MISS GIBLING

100-100. Hygiene. One credit hour. Either semester. Required of all women students during the first year of attendance at the University.

This course deals with the various factors and conditions which affect the health and efficiency of the student.

131-132. Physical Education. One credit hour. The year. Two hours each week. Required of all women students during the first year of attendance at the University.

One hour floor work including marching tactics, free-hand exercises, light apparatus, folk dancing and games.

One hour out-door sports. Choice of the following:

Fall term—hockey, tennis, archery, playground games.

Winter term—basketball, hiking, games.
Spring term—baseball, track, tennis, archery.

Natural interpretative dancing may be substituted for the required hour of sport or taken in addition.

133-134. Physical Education. One credit hour. The year. Three hours each week for second year students. Required of all women students.

Continuation of Physical Education 131-132 with a required hour of swimming until the test is passed, after which a choice of out-door sport or dancing is given.

PHYSICS

Office, 107 Physics Building

PROFESSORS COLE, EARHART, BLAKE, AND ALPHEUS W. SMITH, ASSISTANT PROFESSOR HEIL, MR. WOODBURY, MR. ALVA W. SMITH, MR. JARVIS, MR. WARD, MR. LOWRY, MR. BROWN, AND DEPARTMENT ASSISTANTS

111. General Physics. Three credit hours. First semester. Two recitations and two laboratory hours each week. Architectural, Ceramic, Chemical, Civil, Metallurgical, and Mine Engineering, second year. Prerequisites, entrance physics and Mathematics 132. All instructors.

112. General Physics. Three credit hours. Second semester. Two recitations and two laboratory hours each week. Architectural, Ceramic, Chemical and Metallurgical Engineering, second year. Prerequisite, Physics 111.

A continuation of Physics 111.

113. General Physics. Five credit hours. First semester. Four recitations and two laboratory hours each week. Electrical, General and Mechanical Engineering, second year. Prerequisites, elementary physics and Mathematics 132. All instructors.

Mechanics and heat.

117. General Physics. Two credit hours. First semester. Two recitations each week in mechanics, acoustics and heat, with demonstrations. Architecture, second year. Prerequisites, entrance physics and Mathematics 132. Mr. Cole.

118. General Physics. Two credit hours. Second semester. Two recitations each week in electricity and light, with demonstrations. Architecture, second year. Prerequisite, Physics 117. Mr. Cole.

119. General Physics. Three credit hours. Second semester. Three recitations each week. Mechanical Engineering, second year. Prerequisite, Physics 113. Mr. Cole, Mr. Woodbury.

125. General Physics. Five credit hours. Second semester. Four recitations on text and two laboratory hours each week. Civil, General and Mine Engineering, second year. Prerequisite, Physics 111. Mr. Earhart.

129. Electricity and Magnetism. Two credit hours. First semester. Two recitations each week. Electrical Engineering, second year. Concurrent, Physics 113.

130. Electricity and Magnetism. Six credit hours. Second semester. Three recitations and six laboratory hours each week. A continuation of Physics 129. Electrical Engineering, second year. Prerequisites, Physics 113 and 129.

132. Wave Motion, Sound and Light. Two credit hours. Second semester. One recitation and two laboratory hours each week. Electrical Engineering, second year. Prerequisites, Physics 113 and 129; concurrent, Physics 130.

135. Electrical Measurements and Photometry. Five credit hours. First semester. Two recitations and six laboratory hours each week. A continuation of Physics 134. Electrical Engineering, third year. Prerequisites, Physics 114 and 134, Mathematics 141-142. Mr. Alpheus Smith, Mr. Alva Smith.

138. Physical Laboratory. Two credit hours. Second semester. Four laboratory hours each week. Mechanical Engineering, second year. Prerequisite, Physics 111; concurrent, Physics 112. Elective, three to five credit hours. Mr. Heil.

139-140. Advanced Electrical Measurements. Three to five credit hours. The course may be elected either semester. Prerequisite, Physics 135 or equivalent. Mr. Alva Smith.

This course is subject to considerable variation to meet the needs of individual students, but a large amount of time is always devoted to the study of alternating and transient currents with the oscillograph.

123-124. Advanced Laboratory. Three to five credit hours. The year. Prerequisite, Physics 121-122. Mr. Heil.

144. Electricity. Three credit hours. Second semester. Prerequisite, Physics 103-104 or 105-106; calculus should precede or accompany. Mr. Earhart.

FOR GRADUATES

201-202. Research Laboratory.

203-204. Theoretical Mechanics.

205-206. Thermodynamics and Electrolytic Conduction.

***207-208. Theory of Electricity and Magnetism.**

***211-212. Theory of Oscillations with Applications to Wireless Telegraphy.**

213-214. Conduction of Electricity Through Gases and Radio-activity.

217-218. Electronic Theory and Atomic Structure.

For description of graduate courses in this department see the Bulletin of the Graduate School.

ROMANCE LANGUAGES AND LITERATURES

Office, 104 Hayes Hall

PROFESSORS HENDRIX AND MOORE, ASSISTANT PROFESSOR ROCKWOOD
(ACTING HEAD), ASSISTANT PROFESSORS HAMILTON, HACKER,
GUTIERREZ, WILLIAMS, HAVENS, AND CONRAD, MR.
TAILLIART, MISS HIER, MR. SLOAN, MR. SMITH,
MISS BROWN, MISS SCHONS, MR. GRISMER,
MR. FOURE, MRS. ARTHUR, MISS BIGGER,
MR. GRAHAM, MISS TERRY, AND
DEPARTMENT ASSISTANTS

FRENCH

101-102. Elementary French. Four credit hours. The year. Grammar and prose. May be taken by students in any four-year course who enter with no entrance credit in French. All instructors.

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*Not given in 1921-1922

103-104. Modern French Literature. Four credit hours. The year. May be taken by students in any four-year course who enter with two entrance units in French. Prerequisite, French 101-102 or an equivalent. All instructors.

French 104 is given also during the first semester.

SPANISH

101-102. Elementary Spanish. Four credit hours. The year. May be taken by students in any four-year course who enter with no entrance credit in Spanish. All instructors.

The elements of Spanish grammar with abundant oral and written exercises. Elementary reading as a basis for oral and written practice.

103-104. Intermediate Spanish. Four credit hours. The year. May be taken by students who enter with two entrance units in Spanish. Prerequisite, Spanish 101-102 or equivalent. All instructors.

A more comprehensive survey of the form and syntax, with more advanced reading as a basis for practice in speaking and writing.

109-110. Customs and Manners of Spain. Commercial Correspondence. Two credit hours. The year. Prerequisite, Spanish 104.

A course designed to familiarize students with the vocabulary of business and with the forms of Spanish commercial paper and correspondence.

SHOPWORK

Office, 125 Shops Building

PROFESSOR W. A. KNIGHT, MR. BEEM, MR. FOUST, MR. DENMAN,
MR. P. L. WRIGHT, MR. H. R. WRIGHT, MR. SENN, AND
DEPARTMENT ASSISTANTS

105. Foundry Work. Two credit hours. Either semester. One recitation and four laboratory hours each week. Mechanical Engineering, second year.

Exercises and practice on tempering sand and preparing molds of machine parts in sand, core-making, melting iron and brass, and pouring.

107. Chipping and Filing. Two credit hours. Either semester. One recitation and four laboratory hours each week. Mechanical Engineering, second year; Ceramic and General Engineering, alternative with Shopwork 109 and 115, Summer Session. Mr. H. R. Wright and assistants.

Exercises and practice in vise work, including chipping in cast and wrought iron, surface filing, squaring, fitting, finishing, the scraping of surface plates, soldering and brazing.

109. Joinery and Pattern-Making. Two credit hours. Either semester. One recitation and four laboratory hours each week. Ceramic and General Engineering, alternative with Shopwork 107 and 115; Chemical, Electrical, Mechanical, and Mine Engineering during the Summer Session at the close of the first year. Mr. Beem, Mr. Denman.

Exercises and practice in joinery, wood-turning, and pattern-making, including sawing, planing, mortising, framing and other work involving the use of the ordinary carpenter tools, center and chuck-turning and making of finished patterns.

111. Advanced Pattern-Making. One credit hour. Either semester. Three laboratory hours each week. Mechanical Engineering, second year. Prerequisite, Shopwork 109. Mr. Beem.

115. Forging. Two credit hours. Either semester. One recitation and four laboratory hours each week. Ceramic and General Engineering, alternative with Shopwork 107 and 109; Chemical, Electrical, Mechanical, and Mine Engineering during the Summer Session at the close of the first year. Mr. Foust, Mr. Wright.

The use and care of forge, fire and tools. Practice in iron and steel forging, including such operations as cutting, bending, drawing, upsetting, shaping and welding iron; the making, hardening, and tempering of steel punches, chisels and lathe tools.

118. Advanced Forging. Two credit hours. Second semester. Six laboratory hours each week. Elective. Prerequisite, Shopwork 115. Mr. Foust, Mr. Wright.

Various forms of welds in iron and steel; the use of scrolling irons and of forms for duplicating work; annealing; toolmaking, case-hardening; tempering drills, dies and cutters; spring-making; ornamental iron-work; visits to shops.

119. Machine Work. Three credit hours. Either semester. One recitation and six laboratory hours each week. Electrical and Mechanical Engineering, second year. Mr. H. R. Wright.

Elementary exercises on engine lathe, such as plain, straight and taper turning, screw cutting, chucking, boring, filing and polishing, and the use of the drill press.

121. Advanced Machine Work. Three credit hours. Either semester. One recitation and five laboratory hours each week. Electrical Engineering, second year; Mechanical Engineering, third year. Prerequisite, Shopwork 119. Mr. Knight, Mr. H. R. Wright.

A continuation of Shopwork 119 with further practice on engine lathe, planer, shaper, milling machine, grinder, turret lathe and drill press. Work organized and carried out on a production basis, with interchangeable parts, work limits, inspection and standard time.

123. Advanced Machine Work. Two credit hours. First semester. Six laboratory hours each week. Elective. Prerequisite, Shopwork 121. Mr. Knight, Mr. H. R. Wright.

A more advanced course in milling machine work and grinding. Exercises in spur and spiral gear cutting, cam cutting, and differential and fractional indexing.

125. Construction Work. Two credit hours. Either semester. Six laboratory hours each week. Elective. Prerequisite, Shopwork 121. Mr. Knight, Mr. H. R. Wright.

A course in construction work on any piece of apparatus or machinery which may be in course of construction in the shops.

127. Tool Making and Jig Work. Three credit hours. Either semester. Elective. Prerequisite, Shopwork 123. Mr. Knight.

FOR GRADUATES

201-202. Research Work.

For description of graduate courses in this department see the Bulletin of the Graduate School.

SPANISH

(See Romance Languages and Literatures)

UNIVERSITY OF ILLINOIS-URBANA
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The Ohio State University Bulletin is published at least twenty times during the year as follows: Monthly in June, July, August, and September, and bi-weekly in October, November, December, January, February, March, April, and May.

PRESS OHIO STATE REFORMATORY